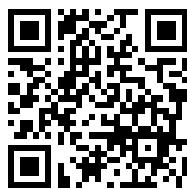

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HISTORY

OF THE

BOLT AND NUT INDUSTRY

OF

AMERICA. /

By W. R. WILBUR.

II

CLEVELAND, OHIO.

1905

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Issued from the Press of
WARD & SHAW
CLEVELAND, O.



1650433

DEDICATION.

Mr. Isaac P. Lamson has been such an earnest and industrious promoter of the publication of this **HISTORY OF THE BOLT AND NUT INDUSTRY OF AMERICA** that it is eminently fitting that the work should be respectfully and cordially dedicated to him.

Becoming practically identified with the great industry early in life, it may be said that he has "grown up with the business." He has not only been a studious observer of the succeeding stages of development in machinery, devices and methods employed in the manufacture of bolts and nuts, but his ingenuity and correct mechanical ideas have contributed in many ways towards perfecting many of the valuable appliances now in general use.

It should be also mentioned that Mr. Lamson's desire that the annals of the bolt and nut industry of America should be carefully collected and preserved, was the chief motive that inspired the publication of this work.

AN ACKNOWLEDGMENT OF FAVORS.

In collecting the information embraced in The History of the Bolt and Nut Industry of America, we have been very largely dependent upon the assistance generously contributed by many who are prominently connected with the bolt and nut business at the present day.

Therefore, speaking for ourselves, as well as for numerous others who are interested in preserving an accurate record of the founding and development of the great industry, we take this occasion to express our gratitude to those who have in many ways assisted in promoting the success of our undertaking.

Conspicuously prominent among those who have freely contributed to the work it is our pleasing duty to mention that veteran inventor and manufacturer, Mr. William J. Clark, who deserves to be called a foster father of the industry, with which he has been identified almost from its infancy.

Since the inception of this history, Mr. Clark has zealously devoted himself to the work of collecting information and data that would be essential to its accuracy and usefulness. He has been consulted at almost every stage of its development and his services have been so valuable that we are moved to confess that our efforts could hardly have been successful without his assistance.

Among the other contributors, whose services have been no less valuable, though less in volume, than those of Mr.

Clark, the following gentlemen deserve and are gratefully extended our sincere thanks:

MARTIN BARNES,	N. F. DUNLEVY,
E. H. PLANT,	JOHN STEPHENS,
H. A. MILLER,	O. C. BURDICT,
S. W. SESSIONS,	H. A. LANMAN,
SAMUEL FRISBIE,	GEO. H. WEBB,
I. P. LAMSON,	WILLIAM GASKELL,
GEORGE DUNHAM,	H. H. CLARK,
J. H. STERNBERGH,	W. HARRY STEDMAN,
J. B. OLIVER,	H. M. GREEN,
C. W. DURSCHLAG,	EDWIN S. TODD,
C. H. CLARK,	GEO. GOLCHER,

JAMES BRADNACK.

PREFACE.

The several contributors to this publication have been so long and closely identified with the growth and progress of the large bolt and nut industry of America, that they deemed it not only a duty and privilege, but essentially a labor of love to aid in the preservation of a carefully prepared and accurate history of its inception, gradual evolution and extraordinary development in the short space of but a little more than half a century.

In obedience to this sentiment and purpose, the utmost effort has been employed to collect and so arrange all facts obtainable in such a manner that the work should prove a valuable history and an exceedingly convenient book of reference.

As the subject-matter of the work is traced from the very beginning, the task of securing trustworthy data was one of considerable magnitude. There were no systematized records to be found that would materially assist in the compilation and hence the facts presented were necessarily gleaned from manifold sources. Fragmentary memoranda, clippings from newspapers, personal letters and other correspondence and many interviews with veterans who had, so to speak, "grown up with the business," were extensively utilized in preparing the history.

After the work of preparation was completed, proofs were submitted to a number of gentlemen whose long connection and familiarity with the bolt and nut business rendered them fully qualified to detect any errors that might have crept into the original copy. The work has been so industriously revised and reviewed that its projectors feel

confident that it is notably free from error, and that they are justified in the belief that they have very successfully accomplished the object of their undertaking.

Only those who have had practical experience in the bolt and nut business can adequately appreciate the magnitude of the industry, the vast amount of capital, labor and costly machinery it employs, the wealth of thought and ingenuity that has been expended in inventing and perfecting machines and devices to prosecute the business economically and successfully, or of the immense commerce it has established, since its first inception, which occurred but little more than half a century ago. Up to that time both bolts and nuts were wrought by hand, and their construction is so simple that the feat could easily be accomplished by any blacksmith or mechanic. Notwithstanding the innumerable uses to which they are put in almost every branch of industry, it had not, up to that time, occurred to any one that it could be made profitable to make them in large quantities and as an article of commerce. Each manufacturer equipped his establishment with the necessary tools to make his bolts and nuts, as they were needed, and some, no doubt, manufactured a small surplus of certain sizes, to be kept on hand for future use. This was the extent of the bolt and nut manufacturing of the world for countless ages, and until near the middle of the 19th century. Yankee foresight, ingenuity and enterprise laid the foundation and erected the stately industrial structure, and there are many living to-day, and still actively identified with the business, who are justly proud of the share that they contributed towards its progress and development.

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THE FIRST BOLT FACTORY IN AMERICA.

SECTION I.

CONNECTICUT.

THE FIRST BOLT FACTORY IN AMERICA.

This venerable structure is one of the most interesting relics preserved in connection with earliest history of the bolt and nut industry of America; and it presents a graphic illustration of the humble nucleus from which sprang what has become one of the most extensive and useful industrial activities of the present day.

The building was designed and built purposely for the bolt business by Rugg & Barnes of Marion, Conn., in 1840, and was used by them as long as they were in the business. After the failure of Martin Barnes, it was sold to L. B. Frost & Sons of Marion, and was not moved from its original site until some years after. In the meantime it was temporarily used as an ivory and bone button shop. It was moved to its present site, which is about 1,000 feet north of where Rugg and Barnes built it, by the Frosts, and has since been used as a wood shed on the premises of Mrs. Mary Frost, widow of Ira Frost, he being one of the L. B. Frost's Sons, and also one of the pioneers in the bolt business.

The building is 30 feet long, 20 feet wide and the posts are 9 feet high. The forging shop was in the left hand end of building, and the packing, shipping and storage room in the right hand end. This room occupied two-thirds of the floor space of the building.

The name of Martin Barnes now shows on the inside of one of the doors, evidently placed there over sixty years ago.

The very first bolts that Rugg and Barnes turned out were made in Rugg's old blacksmith shop, but as soon as Mr. Barnes began to push the business new quarters were necessary, and they built this shop a few feet away from Rugg's blacksmith shop, which was situated on the main street in Marion and in the center of the village.

Micah Rugg's old blacksmith shop, in which he constructed his first machine for making bolts, and where he indulged in his earlier dreams of future achievements, was kindled into flame by a fire in an adjoining building and totally consumed, in 1849.

THE ORIGIN OF THE INDUSTRY OF BOLT AND NUT MANUFACTURE IN AMERICA.

RUGG & BARNES, Marion.

This important branch of American industry originated in the brain of Mr. Micah Rugg, a country blacksmith. Mr. Rugg was born in Southington, Conn. He established his blacksmith shop in the small village of Marion, Southington Township, Conn., in the year 1818. Being of an ingenious and inventive turn of mind he occupied his spare time in making a superior class of tools to those then in use. He made scythes, steel traps and bolts. His scythes became celebrated, and were much sought after by farmers. His steel traps found a ready market in the South, and his bolts were mostly used by himself in job or repair work, but he occasionally sold them at an average rate of 16 cents a piece. In studying the best methods of making tools to manufacture these implements he finally invented and brought out two machines for making carriage bolts. The first machine was a vise arrangement, known as the heading block, operated

with the foot by means of a treadle connected to a lever, which held the blank firmly while the head was being driven down or formed with a hand hammer. The square iron was first rounded enough to admit of the proper length of thread and cut off from the bar, leaving the requisite amount of stock on the square end from which to forge the head, the bolt being all square except the head and thread.

On the second machine he secured a patent for trimming bolt heads, dated October 22, 1842, recorded in patent office August 31, 1842. This machine was operated with a hollow punch, in which the bolt was placed and forced through a trimming die. This was the starting point that led to bolt turning, and it appears to be the original patent on record in the United States Patent Office for carriage bolt machinery. This device was followed by the old hammer turning lathe, a description of which as more fully developed and made practical by Mr. Martin Barnes in after years may not be out of place here. It consisted of a hollow cast iron shaft and frame-bed, not quite as neat a design, but otherwise very similar to the hand turning lathe now in use. The shaft contained a grooved holding device, minus the customary coiled spring, but extending through the rear end of the cast spindle and held in position by a key or flat taper pin in such a manner as to be struck powerful blows with a heavy swinging hammer hung on pivots and operated with a treadle by a quick action of the left foot, thus necessitating the driving of the bolt blank into the square grooved end of the holder with a hand hammer. Then the heads were turned or trimmed with a hand tool and removed by jars given by the strokes of the swinging sledge hammer, the lathe requiring to be stopped to replace each bolt.

Up to 1839 Mr. Rugg's books show a total manufacture and sale of about 3,000 bolts. During this year he devoted his whole attention to bolt and nut making. The following year, 1840, he took in as partner Mr. Martin Barnes, con-

stituting the firm of Rugg & Barnes, the first company to manufacture bolts and nuts for the trade in America. Six operatives were employed, with a daily production of 500 bolts, consuming less than 60 pounds of Stitt's best brand of refined English bar iron, purchased at \$140.00 per ton in New Haven and hauled with ox teams to Marion, a distance of 18 miles. About 300 pounds of Lehigh lump coal was used, costing \$12.00 per ton on the docks and also transported to the factory by teams of oxen. The monthly pay roll amounted to \$150.00, payable largely in due bills and store orders; there being no regular pay day, notice was required to get cash as part payment.

During the years 1840-41 and 42, Mr. Barnes invented and constructed with his own hands his first machine for cutting threads on bolts, also the first rounding or swaging press and a trimming machine for edging bolt heads. These machines, with the exception of a trimming tool, were for some cause not patented, although Mr. Barnes went to Washington and in person sought patents. Some trifling "red tape" is alleged as the cause of failure. The patents, if issued, would have enriched not only the inventor, but the entire town. With the aid of these machines and the introduction of water power, the power previously employed being a bull and tread mill, the output of manufactured goods was very materially increased. Their mode of manufacture before the introduction of their improved machinery was as follows: First, the ends of the square rods of iron were placed in a forge, heated to the required degree, rounded the necessary length with hand or dolly swages, the top swage or "jumper" being held in position with a handle extending back and hinged to an arm attached to the anvil in such a manner as to allow the upper swage to lift and admit the square iron between the swages, the rounding being done by striking the top swage with a hand hammer. The blanks were then cut off, leaving the required amount of stock, as

before described, to form the head. Second: These pieces were reheated, placed in a countersunk heading tool and the stock driven down with a hand hammer, leaving the top flat. Then they were reheated and the head was forged to the proper size and shape with a hardened steel head former firmly held in a drop hammer operated by the foot by means of a rope passing over a shieve pulley. The large bolt heads formerly used required so much stock that it could not be driven down centrally, hence this process was adopted. Third: The blanks were then taken to the edging lathe, consisting of a square shaft, turned far enough on each end to admit of a pulley and journals which were babbitted in a wooden frame, the front end having two loose grooved V-shaped holders between which they were clamped and the heads neatly trimmed with a hand tool (made something after the pattern of a 12-inch flat bastard file bent up at the point $1\frac{1}{2}$ inches, near to a right angle). They were removed by means of a set screw and wrench, the lathe being driven by foot power and brought to a halt with a brake, the unscrewing of the set screw necessitating the stopping of the machine to replace each bolt. Fourth: The threads were cut by placing the square neck of the bolts in a holder on the end of a small shaft attached to a crank and swivel, the points being entered between a pair of threading dies. The crank then revolved forward and backward with the right hand; at the same time the dies were forced together by means of a lever passing under the left arm until threaded to the desired size and length. Fifth: The nuts were made on an anvil. The ends of the flat rod were heated, placed against a spring gauge, made in the form of the letter C, the correct amount of stock cut off with a hand hammer and hardy, placed in a square shallow socket containing a central punching hole and the piercer driven through, lifted out and hammered smooth while hot and held on the punch. They were then threaded with an old-fashioned square plug tap, by

hand, and promiscuously thrown together with the bolts (uncleaned) into a nail keg or cheese box. This completed the process of bolt and nut making more than sixty years ago. Although at this time in possession of bull and water power they made no further use of it than to blow their fires, the bolts and nuts being practically made with machines, operated entirely by hand or foot power. Messrs. Rugg & Barnes adopted the piece work system, paying per 100 as follows: Five-sixteenths carriage bolts, heading 30 cents, swaging 20 cents, trimming 15 cents, threading 10 cents, tapping 10 cents, forging nuts 20 cents; time work per day of from sun to sun or an average of 12 hours, \$1.00; average wages, \$1.00; 5-16 were the only diameter made complete at this period and they were in assorted lengths. Cost of labor per 1,000 finished bolts, \$12.50; selling or exchange value, \$30.00.

The business management was conducted by Mr. Barnes, Mr. Rugg taking charge of the mechanical department. Mr. Barnes experienced considerable difficulty in introducing their goods on the market. He made monthly excursions to New Haven to purchase supplies and endeavor to dispose of his bolts in the way of trade or exchange. To sell for cash or even secure orders was absolutely out of the question. It was almost impossible to persuade hardware merchants to exchange merchandise for bolts and nuts on any terms; they were averse to receiving that class of carriage goods even on commission. Mr. Barnes was looked upon with suspicion; his bolts were considered bogus and were thought to be made of some kind of cast iron. Carriage manufacturers would have nothing to do with him or his bolts. Their carriagesmiths pronounced the bolts good for nothing and manufactured from "pot metal," made malleable by some mysterious and fraudulent "Yankee" process. They examined his samples generally with their teeth or a jack-knife and with a smile suggestive of wooden nutmegs or bass wood hams, would invariably say: "Guess we don't want

any; good day." The fact was that Rugg & Barnes finished their work too well. The bolts and nuts were too good, too neatly made and the price too low. They were ahead of their time.

Up to 1840 and for years after, the manufacture of carriages, wagons, etc., was confined wholly to the Northern States. The factories were mostly located in the New England States, and their bolts and nuts were made at the blacksmith's forge for their consumption. Previous to 1838 no bolts nor nuts had been put on the market or offered to the trade, hence the distrust.

Messrs. Rugg & Barnes were determined to succeed. Mr. Barnes would load his wagon with goods and drive long distances to market. There was no other conveyance except by canal, which was a rather slow delivery, reaching comparatively few places; the canal railroad not being opened to the public until July 4, 1847. To use Mr. Barnes' words: "By leaving my bolts with hardware men, carriagesmiths and blacksmiths on approbation, in the course of time they were willing to take them in exchange for their own class of manufactured goods or for steel, iron and supplies." In other words, in dealing with carriage makers, carriages were taken in exchange for bolts and nuts; with hardware merchants, steel, iron and supplies, and so on with all classes of business men, taking whatever they manufactured or dealt in for bolts by way of trade. The firm's books (some of which are in the hands of the writer) show such a large variety of goods entered as to convey the idea that this company did a tremendous amount of business. In this manner of barter and trade the bolt and nut business was established and carried on for years, and it has not yet entirely disappeared from this section of the country.

One hundred and twelve pounds of iron was calculated to make 1,000 5-16 bolts and nuts in assorted lengths as follows: Two-inch, 400; 2½ inch, 300; 3-inch, 200; 3½-inch,

100, and so constituted were established and made the custom of trade, the value being fixed at \$30.00 per 1,000 as the basis of sale or exchange. Three-eighths bolts were rated at \$60.00 per 1,000, the large difference in value between the two diameters being due to the fact that machine tools were made for 5-16 only.

In 1844 tire bolts were first put on the market, the value being fixed at $\frac{1}{4}$ inch per 1,000, \$15.00; 5-16 per 1,000, \$18.00, in assorted lengths as recognized by the custom of trade. The method of manufacture was to cut the round rods to the required length, heat, place in a countersunk hand-heading tool, clamp the portion of the blank projecting through the tool in Mr. Rugg's treadle heading vise and drive the stock into the countersink with a hand hammer, thus forming the head of the bolt. Then it was held while being threaded by placing the blank through a round hole in the holder which was tightened with a screw, the upper part having the form of a crank. This completed the process, there being no rounding or finishing of points in those days. During this year power was applied to machines in the following order: Rolling barrel, tapping lathe, rounding press trip hammer and cutting and turning lathes. An empty oil barrel with an opening of about eight inches in its side, having a closing lid held with leather hinges, trunnions being bolted to each head for axis and driven by a belt passing around the cask, on cleats nailed near one end, answered for the rolling barrel. It was used principally for removing oil, chips, etc., from the nuts and bolts after being threaded, by tumbling them together with leather scraps collected from shoemakers. The tapping lathe was a very simple affair, consisting of a short square shaft, turned up just far enough at each end to admit of pulleys and bearings, the journals being molded in babbitt metal. The front end of this shaft held the square plug taps (no flutes in those days) by means of a set screw. The nut was placed in a holder

and forced on to the tap with a hand lever attached to a square slide. The power was applied with straight and cross belts. The motion could be reversed by a sliding clutch operated between the pulleys. From 1,500 to 2,000 nuts were tapped per day. The trip hammer was used for rounding or swaging. It was superseded by the rounding or rattling press, as sometimes called. This important machine was invented by Mr. Barnes in 1840, but for reasons best known to the inventor never came to the front until Mr. Barnes bought out Mr. Rugg. Some valuable improvements in cutting threads were also made during 1844-45. The hand lathe was remodeled and rebuilt. Three pulleys were added, the center being made fast with slips on either side; a tail screw coupled to the back end of the spindle and run in hardwood boxes; belts transmitted the power in the same manner as the tapper, which was guided by a shifter connected to a treadle and operated by the foot, reversing the machine at will. The bolts were held in a holder by the square neck, while a solid cutting die was being run up the necessary length and backed off by means of the double belts and tail screw. It would thread nearly the same amount as the tapping lathe.

About this time, 1844, Mr. Barnes invented the edging tool, on which a patent was issued to Mr. Rugg, who afterwards assigned one-half to Mr. Barnes. This tool for trimming bolt heads was the ordinary square turning tool forged from solid cast steel in such manner as to form a shank to receive a long wooden handle and produce a cutting edge on each of its four sides.

In the words of Mr. Barnes, "It was one continuation of improvements during my connection with the business, until I bought Mr. Rugg's interest in 1845, for the consideration of 10,000 finished carriage bolts, assorted lengths, in conformity with the prevailing custom of trade, equivalent to \$300, and Mr. Rugg agreeing never to enter into the bolt

business again. The edging tool was my own invention, though the patent was issued to Mr. Rugg, who afterwards assigned one-half to me."

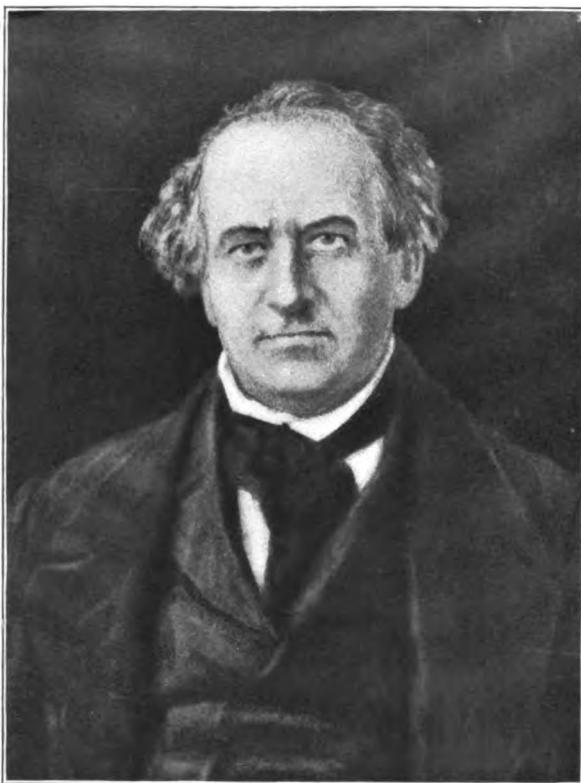
Mr. Barnes conducted the business for two years, and went down with the financial crash of '47. He was obliged to sign over all his property to Joel Parker to satisfy notes held by him. Mr. Barnes represented the factory two years in Mr. Parker's name. In 1849 the whole concern was sold to L. B. Frost & Son, leaving Mr. Barnes in debt and without a cent; having invested every dollar and more, too, in the business, he lost it all, absolutely everything. Mr. Barnes attributed his failure to the hard times or money panic of 1847, brought about by the heavy failures in England. Thus ended the first bolt and nut company and first effort to plant a new industry in this country.

The following communication is from the pen of a leading business man and highly esteemed citizen of New Haven, Conn., who was formerly senior partner of the well known hardware firm of Atwater & Bassett, and written in answer to inquiries of Mr. Martin Barnes of Marion, Conn.:

OFFICE OF THE N. H. & D. R. R. CO.,
NEW HAVEN, CONN., FEB. 22, 1887.

Friend Barnes:

I was pleased to hear from you and be reminded of old times. You were the pioneer in the manufacture and sale of bolts, as far as I know. I know that you were the first to introduce them to me. I well remember of your bringing samples of your bolts to my store on Chapel Street in the winters of 1839-40, and how difficult it was to induce the carriage makers and others to use them. I also recall to mind your enthusiastic confidence in the future of carriage bolts, and congratulate you on having lived to see the business so useful and extended as it is to-day. Hoping you still continue the pleasant and social nature which I so well remember, I am, Truly yours, CHAS. S. ATWATER.



Micah Rugg

MICAH RUGG.

It is fitting that a brief mention should be made of the mechanical genius who struck the first blow in the manufacture of bolts and nuts as a commercial business in America, whose portrait is shown herewith.

History fails to record that Micah Rugg was "a village blacksmith" of the type described by Longfellow. He did not pose for poetical snap-shots, "under the spreading branches of a chestnut tree," nor did he idle away his time in furnishing food for poets. He was a "mighty man," nevertheless; and the force of his might has ineffaceably stamped itself on the great industry that engaged his physical and inventive effort.

Micah Rugg was a practical and hard-working blacksmith in the little village of West Street, now Marion, Conn. His ideas were progressive and his mind was always busy. His success in manufacturing a variety of useful implements that found ready sale on the market within his reach, fed his ambition and stimulated his inventive genius. As a result, Micah Rugg became the first inventor of machines for the purpose of manufacturing carriage and other bolts, thereby sowing the seed that was destined to fructify and produce at the harvest, one of the most useful and valuable industries in the annals of mechanical history.

"Tall oaks from little acorns grow,
Large streams from little fountains flow."

The history of Micah Rugg is suggestive of these familiar lines. In his little blacksmith shop in the West Street settlement he was a delver and an inventor. His sinews and his mind were industriously employed — his sinews earning the wherewithal "to keep the wolf from the door" and his mind haunting realms remote in search of mechanical wonders.

Mr. Rugg was born in Southington, Conn., June 18,

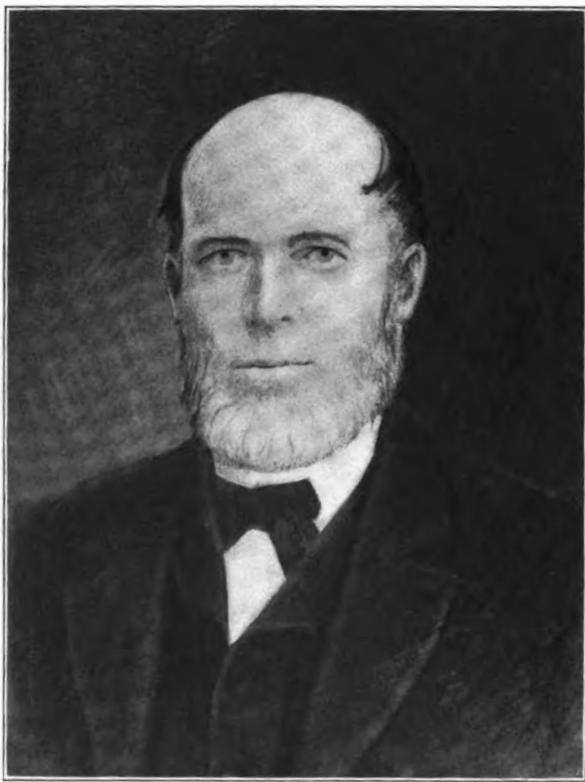
1793. He established his shop in a small village known as West Street, Southington Township, Conn., in 1818. Besides doing a general blacksmithing business, he made scythes, edged tools, steel traps and other articles of such a superior quality that they found a ready sale in the markets where they were introduced. While engaged in a fairly prosperous business, he invented, built and operated his machine for making carriage bolts, which he duplicated and which was the first invention of the kind in America. A full description of this machine will be found elsewhere in this history.

In 1840, after varied experience with his bolt machines, Mr. Rugg formed a co-partnership with his neighbor, Martin Barnes, establishing the firm of Rugg & Barnes, whose history will also be found in this volume.

This co-partnership was dissolved in 1845, when Mr. Rugg sold his interest in the factory to his partner, Mr. Barnes, and temporarily retired from business.

In 1851, when Mr. William J. Clark started in the nut and bolt business in Milldale, Conn., Mr. Rugg was the first mechanic employed, in which position he rendered the most valuable services, in arranging and organizing the mechanical department of this prosperous establishment. About two years later Mr. Rugg permanently retired from active business. Although Mr. Rugg had failed to completely realize the bright anticipations of his early dreams, he had accumulated a comfortable competence and, in his declining years, he, no doubt, enjoyed the proud conviction that he had not wrought in vain, and that he would be honorably remembered in history as the inventor and constructor of the first machine ever designed in America for the manufacture of carriage bolts. It also stands to Mr. Rugg's credit that he was the first to recognize the practicability of introducing this valuable commodity to the general market.

Mr. Rugg died at Southington, Conn., March 8, 1857.



Martin Barnes

MARTIN BARNES.

Mr. Martin Barnes, one of the first to embark in the bolt and nut industry, was a farmer in the little town of Marion, Conn. In the year 1840, he formed a co-partnership with Mr. Micah Rugg, of the same village, who had invented two bolt machines of a very primitive construction, and was manufacturing carriage bolts in a small way to supply the demands of an extremely limited market.

As junior member of the new firm of Rugg & Barnes, Mr. Barnes had charge of the business affairs of the concern, and also devoted a large share of his time and ingenuity to the devising of improvements on the crude machinery employed, and during the following five or six years he perfected a number of devices that proved very valuable. Among these was the first machine ever invented in the United States for cutting threads on carriage bolts by power, which he constructed with his own hands, a swaging press and a trimming tool for edging the heads. These and other devices invented by Mr. Barnes were instrumental in giving an impetus to the then entirely new industry that subsequently developed into the enormous bolt and nut manufacturing business of the present time.

Unfortunately Mr. Barnes did not succeed in reaping the deserved fruits of his clever ingenuity and earnest labors. It was his fate to succumb, like many others, to the ravages of the financial panic of 1847, which left him penniless. He recovered from his downfall in due time, and though disappointed at being unable to profit as he hoped from the fruits of his early inventions, he became fairly prosperous and lived to witness and feel proud of the wonderful development of the industry to the promotion of which he had largely contributed and the ultimate success of which he had foreseen.

Mr. Barnes was born in Marion, Conn., October 26, 1802,

and died in his native village, at the ripe age of eighty years, on March 20, 1900.

A description of the devices invented by Mr. Barnes and a detailed account of his business career will be found in another portion of this work.

L. B. FROST & SON.

Marion.

A unique establishment, and one that was entirely typical of the business methods of the early days, was that of L. B. Frost and his son, Ira S. Frost, who conducted a blacksmith shop a short distance north of Rugg & Barnes, in the settlement of West Street, now Marion, Conn.

These were the days of traffic and exchange, and Frost & Son carried the principle so far that they dealt in almost everything portable, from horseshoe nails to agricultural implements, and from scrap iron to live stock. They did such a general bartering business that their shop became a headquarters for farmers' supplies of every description. Here could be found cooking stoves, kitchen utensils, plows, harrows, scythes and an endless variety of other articles too numerous to mention. With true Yankee enterprise they were always open for a trade and it mattered not whether it was for tools and implements or for horses, cattle, hogs or sheep; everything was fish that came to their nets. They also conducted a general country store, supplying their help with every kind of merchandise.

In the year 1842 they embarked in the bolt business, employing from six to ten hands and producing from 500 to 1,000 finished carriage bolts per day. Their first forging and rounding was done in the blacksmith shop while their factory and water power were being built on the opposite side of the road. At this time they originated their first

lathe for turning bolt heads. It was a home-made affair; the bolt was held in the lathe by a set screw, and the belt was shifted to stop the lathe for each bolt turned. Not having power on their premises they hired room and power from A. P. Plant & Co., at Plant's Corners, who were at the time manufacturing tug and hitching snaps and other harness furnishings. Ira S. Frost operated the lathe, carrying the bolts two miles, back and forth each day, during the first winter. It was through seeing the operation of this machine that the Plants became interested in the bolt business.

In 1844 they first began making nuts, with an old-fashioned, open-back Atkins and Allen press, built in Bristol, the frame of which was held in position by being mortised into and supported by and between two heavy oak planks, extending from floor to roof. The nuts were mostly made from old boiler plates, cut in convenient sizes to handle. These plates were pickled in a solution of sulphuric acid and water, which removed all scale and rust. They were then washed, dried, soaked in whale oil and made into nuts, by punching rows of round holes and then pressing through a die, with a square or hexagon cutting-out punch, producing the nuts cold with two operations. Mr. Moses Chandler was the first to operate this press, followed by Mr. Edward Bergen, who, at a later date, contracted to make all sizes of "cut" or cold pressed nuts from one-quarter to one-half inch, bolt size, at the rate of \$1.25 per 100 pounds. Water power was obtained from a small mountain stream, known as Judd Brook.

On April 1, 1848, Aaron Moss was admitted to the firm and the style was changed to Frost, Moss & Co. In 1851 Moss withdrew and Lewis H. Frost was taken in as a partner, at which time the firm was changed to L. B. Frost & Sons.

This same year they enlarged their facilities by building a new front, engine and boiler house, employing steam power with corresponding additional machinery, gradually branch-

ing into the manufacture of machine, spring and plow bolts, coach screws, axle clips, etc. The spring bolt heads were central and of the "cheese head" type, the latter name of head being better understood by bolt workers.

The coach or lag screw heads were forged square by hand. The points were drawn out to a rough point while hot under the trip hammer and the screw thread cut with a solid threading die.

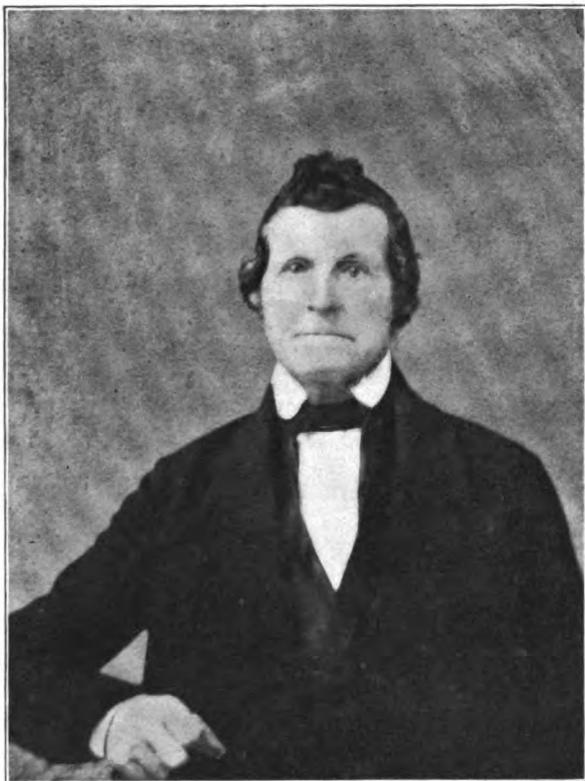
The machine bolts were hand-made square heads, screwed by the usual method, with unfinished points. The plow bolts were forged on Rugg's heading vise from round iron by being heated on the rod, cut off in the same manner as carriage bolts and headed in a countersunk hand tool of the pattern desired.

In 1849 Frost & Sons bought from Mr. Joel Parker Mr. Barnes' entire plant, tools, etc., and continued successfully through the early fifties, keeping abreast of the times, reaching the summit of their prosperity in 1856, purchasing the Chapin heading machine in the latter part of the year 1857.

The bolt and nut industry had now grown to such an extent as to call the attention of other inventors to this class of machinery. The result was a multiplicity of important inventions, tools, etc., a history of which is given elsewhere in this work, including a full and descriptive history of the Chapin header, under the head of machinery.

During this year (1857), business circles were shaken by the financial panic, and 7,200 firms failed for more than \$110,000,000. Frost & Sons struggled hard during 1858 and 1859 and successfully weathered the storm.

In 1860, L. B. Frost retired from business, and a new firm, consisting of Ira S. Frost, Lewis H. Frost, Levi D. Frost and Elbert E. Thorpe, was established under the title of Frost Brothers & Co. Mr. Thorpe withdrew at the end of one year and the firm was changed to Frost Brothers, who



Lori B Frost

continued until the spring of 1863, when the entire business was closed out, the machinery disposed of and all of their obligations settled in full.

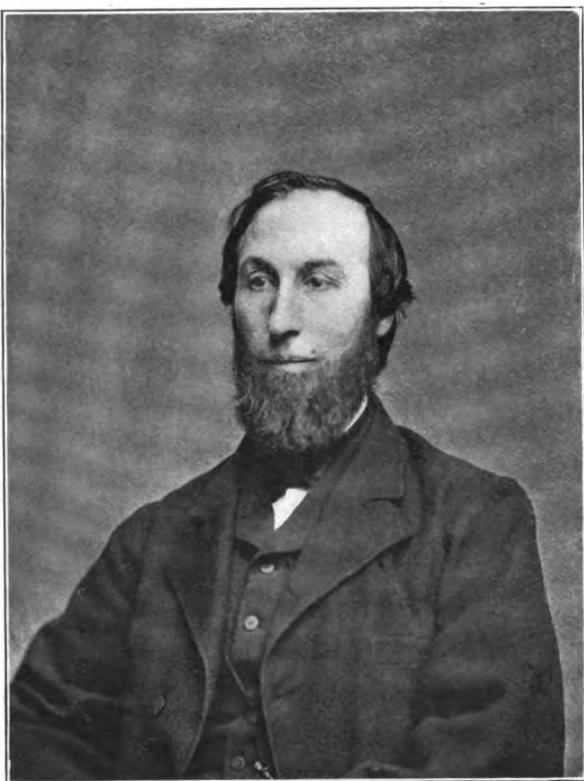
On January 1, 1866, Levi D. Frost and Elbert E. Thorpe established the firm of Frost & Thorpe, and resumed business in the same building. In 1871 Mr. Thorpe withdrew, and L. D. Frost continued the business until May, 1883, when his two sons, Edson L. and Edgar W. Frost, were admitted as partners under the firm name of L. D. Frost & Sons. Edson L. Frost died September 6, 1890. Edgar W. Frost died August 11, 1899. L. D. Frost again conducted the business in his own name, until his death, October 14, 1900. He provided for a continuance of the business by will, leaving the factory portion of his estate in trust to his nephew, James W. Frost, who had been in his employ since 1875, and a son-in-law, Clifton I. Stone, who still conduct the establishment. The first building occupied by L. B. Frost & Son, erected in 1842, is still standing and in good condition. It has been continuously used as a bolt and nut factory, with the exception of three years, between 1863 and 1866. It is 25 x 40 feet and two and one-half stories high. No part of the works has ever been destroyed by fire. Charcoal was the only fuel used in the early manufacture of bolts. Prior to 1850, all iron and coal was carted by horses or oxen from Hartford or New Haven, a distance of twenty miles, and the product of the factory was transported in the same manner for shipment.

LEVI BROWN FROST.

Levi Brown Frost, one of the earliest experimenters to embark in the manufacture of bolts in America, was born amid the rugged scenery of the Wolcott Mountains at Wolcott, Conn., August 21, 1794. After serving his apprenticeship as a blacksmith, in his native village, he removed to

Marion, Conn., where, in 1819, he opened a blacksmith's shop and conducted a very prosperous business for many years. This shop became locally famous, as it was the only place in that section of the country where the shoeing of oxen was a specialty. This work was performed with the assistance of a peculiar contrivance, invented by Mr. Frost, which securely confined the animal while the operation of shoeing was being performed. This unique device gave Mr. Frost a local monopoly on shoeing oxen, and his patrons came from a circuit of many miles. While engaged in a general blacksmithing trade, he formulated plans for manufacturing carriage bolts for the market, and, in 1842, he embarked in this line of business, taking his son, Ira S. Frost, into partnership and establishing the firm of L. B. Frost & Son. A complete history of this extensive enterprise, which passed through a succession of changes in later years, will be found in another portion of this work. Mr. Frost was a man of sterling integrity and thorough business habits. He was also public-spirited and devoted much of his time to matters of public interest. Beside representing his district in the state legislature, he was elected several times to responsible town offices. In addition to his interest in the bolt factory, he owned a large farm, which, with his blacksmith shop, he continued to manage until his death. In 1855, when the Wonx Spring Cemetery Association was organized, Mr. Frost and Mr. Levi Newell donated the entire land for the cemetery site, which was picturesquely located on the plains near the village. Mr. Frost aided in promoting many public improvements in Marion, and although never ostentatious in the bestowing of charity, he was a liberal sharer in all benevolent undertakings.

Mr. Frost died at his home in Marion, December 28, 1865, at the age of 71 years.



A.P. Plant

A. P. PLANT & CO.

Plantsville.

How they built a Flourishing Manufacturing Town and
controlled the Bolt and Nut Business for nearly
a Quarter of a Century.

A. P. Plant, E. H. Plant and Alfred Hotchkiss, under the firm name of A. P. Plant & Co., were the fourth to successfully manufacture carriage bolts, commencing in the fall of 1842. They located their factory in a then very sparsely populated part of the town known as the "Corners," about midway between Marion and Southington Center, on the west bank of the Quinnipiac River, north side of the main road (now Main Street), using the river for their motive power by cutting a raceway through from near the location of the present Southington railroad depot, and conducting the water a distance of fully three-fourths of a mile to drive their under-shot paddle-wheel. This raceway or ditch formed what was afterwards known as the island. A busy manufacturing village rapidly sprang into existence, naturally acquiring the name of Plantsville.

Messrs. Plant & Co. were thorough business men, practical and systematic. They began with the Rugg & Barnes method of making hand-swaged and headed bolts, soon increasing the sizes either way from 5-16 to $\frac{1}{4}$ and $\frac{3}{8}$, turning the heads, cleaning, screwing on of the nuts, piling and papering them in packages of 50 and 100, convenient for merchants to handle, labeling the number, size, length and kind and fixing a list price to each package, size and length of bolts, thus placing them in the list of shelf, carriage hardware and making them an article of merchandise; in fact permanently establishing a new article of industry, in which Plant & Co. were in reality the most successful pioneers.

During the summer of 1843 Mr. Hotchkiss personally endeavored to introduce bolts in the New York market, traveling by canal boat to New Haven and crossing the sound in a schooner. His efforts were met with very little favor, he barely persuading a few merchants to receive small lots on commission, subject to unconditional sales. This demonstrated the necessity of putting up bolts in packages presentable to the trade and the adoption of a price list, which occurred in 1844. The following is a copy of the first list introduced:

PRICE LIST.

Of carriage and tire bolts, manufactured from best refined iron, by A. P. Plant & Co., Plantsville, P. O. Address, Southington, Conn.:

ONE-QUARTER INCH CARRIAGE BOLTS TURNED HEADS.

400	2	inch per hundred.....	\$2.70	\$10.80
300	2½	" " "	3.00	9.00
200	3	" " "	3.30	6.60
100	3½	" " "	3.60	3.60
				<hr/>
				\$30.00

FIVE-SIXTEENTH INCH CARRIAGE BOLTS TURNED HEADS.

400	2	inch per hundred.....	\$2.70	\$10.80
300	2½	" " "	3.00	9.00
200	3	" " "	3.30	6.60
100	3½	" " "	3.60	3.60
				<hr/>
				\$30.00

THREE-EIGHTH INCH CARRIAGE BOLTS TURNED HEADS.

400	2	inch per hundred.....	\$4.50	\$18.00
300	2½	" " "	4.70	14.10
200	3	" " "	4.90	9.80
100	3½	" " "	4.10	4.10
				<hr/>
				\$46.00

ONE-QUARTER INCH TIRE BOLTS.

400 2	inch per hundred.	\$1.35	\$ 5.40
300 2½	" " "	1.50	4.50
200 3	" " "	1.65	3.30
100 3½	" " "	1.80	1.80
Per thousand.			\$15.00

FIVE-SIXTEENTH INCH TIRE BOLTS.

400 2	inch per hundred.	\$1.65	\$ 6.60
300 2½	" " "	1.80	5.40
200 3	" " "	1.95	3.90
100 3½	" " "	2.10	2.10
Per thousand.			\$18.00

Carriage bolts with countersunk heads, furnished to order at prices same as for regular kind of carriage bolts.

Extra or intermediate lengths furnished at proportionate prices.

Machine bolts with square heads furnished to order, on favorable terms.

Orders solicited and executed with promptness on the most reasonable terms.

A. P. PLANT & CO.,
Manufactory, Plantsville, one mile south of Southington,
Conn.

This price list was printed on a pasteboard card and accepted by all firms at that time in the business. Soon after, A. P. Plant & Co. began cutting rates or discounting the list prices, forcing all others to imitate or go to the wall, the discount reaching 20 per cent. off the list price up to and during 1847.

Plant & Co. continued to increase their business, even during the money crisis, the panic having no apparent effect on them.

Mr. E. H. Plant, under date of January 12, 1888, wrote of this period as follows:

"Our power had become insufficient for the increasing business. In 1847 we built a dam six feet high across the Quinnipiac River, about 100 rods north of the main street, by which we procured quite a reservoir. By uniting this pond (now called 'Stow's pond') with our raceway, we increased our power considerably. We also built shops in connection with this pond, both for forging and finishing. By this means our facilities for manufacturing were nearly or quite quadrupled. At this time our business was increasing so rapidly that we again added to our facilities by purchasing a mill privilege known as 'Copp's mill,' located about one-third of the distance below the last factory, on the bank of the 'old canal,' midway between where the works of Messrs. H. D. Smith & Co. is now located, and the present railroad, this being on the 'eight-mile river,' so-called. Here we built a shop for rounding the bolts, which at that time was done by rollers much more rapidly than with presses, using the old mill for turning the heads. Thus we were running three factories at the same time within a radius of about one-third of a mile. On the building of the canal-railroad, about 1847-48, we conceived the idea of building a dam against the road-bed sufficiently high to include the aforementioned privileges. This was an expensive undertaking, but it enabled us to consolidate our works at one point, and we sold our 'north shop' and water power to the S. Stow Manufacturing Company, which is now the location of the Peck, Stow & Wilcox Co. in Plantsville."

The process of rolling the square iron round, while hot, for carriage bolts, was a pet method of the Plants. It gained considerable favor with the other bolt makers, for a time, but, however, eventually died a natural death. The rolls were introduced about 1848. They consisted of the ordinary half rolls, geared together and running continuously, the iron

being rounded by pushing the rod into the space and rolling it out towards the operator, requiring six or eight passes to finish the round, the blank being then sheared off from the rod, and headed with the English Oliver, which had found its way to Plantsville with a somewhat novel shaped anvil block, having but one swinging hammer. It was known here as the "jackass header." It continued in use for nearly twenty years. When the canal railroad was opened a station placed at their very doors, named "Plant's Station," taking its name from the company, excellent facilities were afforded for receiving and shipping goods. In 1850, or thereabouts, the buildings were enlarged to make room for Captain Julius B. Savage, who commenced the manufacture of cut or cold pressed nuts and washers, supplying Messrs. Plants with a new commodity. Prior to this Messrs. Plant had made nuts for their own use only with presses built by Messrs. Atkins, Allen & Co., of Bristol. The old hammer-turning lathe had now been made to run constantly while the bolts were introduced and removed. Small orders for larger sizes of carriage and machine bolts began to appear. About this time the introduction of agricultural machinery commenced and steadily increased the demand for bolts, nuts and washers, especially of the larger sizes. This demand made it necessary to provide additional facilities as rapidly as possible.

The demand for this class of goods continued to increase to such an extent as to far exceed the capacity of the three factories in the year 1852. At this juncture Messrs. A. P. Plant & Co., true to business instincts, resolved to secure, if possible, absolute control of the business they had labored so industriously to establish and which they aimed to exclusively control throughout the whole country, by forming a joint stock company sufficiently large to erect all necessary additional buildings, enlarge their water power with a higher dam, to build or purchase additional machinery, including steam engine and boilers, and thus to virtually monopolize the entire

bolt and nut business. This they accomplished with but two important exceptions, namely, Coleman Bros., of Philadelphia, and Messrs. Russell, Burdsall & Ward, of Port Chester, N. Y., who still remained in the field as worthy competitors.

In a personal letter, referring to the Plant Company being the first to introduce bolts and nuts to the New York market, Mr. E. H. Plant writes: "I desire to state, however, that we sold our first bill of carriage bolts in the Boston market, Mr. S. H. Dodge very reluctantly consenting (as a personal favor) to receive 1,000 assorted sizes. This was the commencement of an enormous trade in this line of goods by Mr. Dodge, and his successors, Dodge, Gilbert & Co., who nearly controlled the entire market east of Boston, their purchases running up into the millions.

"The first price list we issued was on a piece of pasteboard about 6 inches long by 4 inches wide, of regular sizes, $\frac{1}{4}$, $\frac{5}{16}$ and $\frac{3}{8}$ iron; the retail price was about 6 cents each.

"The turning lathes used at first were ordinary lathe heads, in which the bolt was held by turning a set screw. This necessitated the stopping of the lathe for each bolt. A. P. Plant & Co. built the first lathe to run continuously, the dies being opened and closed by means of levers and springs. The hammer lathes were an after-consideration.

"E. H. PLANT."

Early in the year 1853 A. P. Plant & Co. successfully organized a joint stock company known as the Plants' Manufacturing Company, with a capital of \$65,000. The board of directors chosen were A. P. Plant, E. H. Plant, Alfred Hotchkiss, Julius Bristol and John Baily. The officers elected were A. P. Plant, president and treasurer; E. H. Plant, secretary; Alfred Hotchkiss, superintendent, better known as "Boss" Hotchkiss. The manufacturing property of A. P. Plant & Co., exclusive of the original factory, was purchased for the sum of \$25,300, machinery, buildings, etc., which they

had accumulated in the first decade of business. Mr. E. H. Plant puts it in these words: "The capital of the A. P. Plant & Co. in 1842 consisted mainly in the factory they occupied and 'habits of industry.'" An additional building, 100 x 30 feet, two and a half stories high, was erected and well stocked with machinery, such as trip hammers, drop hammers, cold nut and washer presses, the largest of these presses being quadruple geared, capable of cutting nuts cold from solid iron 2 inches thick by 4 inches square, with a 2-inch hole; a self-feeding tire heading machine, purchased from the Sanclear Machine Company, of Middletown, Conn., of the same build as described in the Coleman machine with one exception, it having a back gear, the fly wheel being supplied with a pinion. Mr. Jonathan Smith, father of Fred Smith, the present superintendent of the Upson Nut Company's bolt works, Cleveland, Ohio, came with the header, set it up and operated it. The construction of a duplicate of this machine, minus the gears and with some other slight improvements, was almost immediately commenced and rapidly pushed to completion. The water power not being sufficient to run this large increase of machinery, a 25 horse power engine and boiler were added. A new revised price list of carriage, tire and spring bolts was formulated and established, slightly decreasing the list price of the smaller sizes of carriage bolts, tire bolts and nuts. The new pamphlet contained additional tables of the list prices of the following staple articles: Ulster and Norway iron carriage bolts, spring, plow, machine, elevator and bridge bolts, also coach and skein screws, bed screws, set and cap screws, axle clips, Superior and Norway, stump joints, hitching rings, halter and tug snaps, felloe plates, strap hinges, etc., thus making a greater variety of bolts, nuts, washers and kindred articles than any other manufacturer of the period. During the year, over one million carriage bolts were made. This was considered marvelous. The list was adopted and a discount off the list price was agreed to by the different makers

in 1851. The entire stock and machinery of Bristol, Moss & Co., a bolt and nut concern doing business in the south end of Southington, was purchased and removed to the works in Plantsville in 1853.

The next year their capital was increased to \$75,000, and the firm of Clark, Norton & Co., manufacturers of carriage bolts where H. D. Smith & Co.'s works are now located, was bought in.

During the spring their large dam was carried away by a flood, taking a part of the works with it. Of this freshet Mr. Plant writes as follows: "In the spring of 1854 a section of our dam was washed away, carrying with it a large portion of our factory, machinery, tools and stock; the loss was heavy, on which there was no insurance. One shop, two and a half stories high, that we had recently built, was saved, also the finishing room and part of the forging shop. In these were our tire-bolt headers, our nut presses and machinery for finishing tire bolts and the smaller size carriage bolts. With our engine we were able to run this part of our works and commenced at once to rebuild with increased facilities."

In 1855 the wonderful increase of business necessitated the replacing of the 25 horse power engine with one of 75 horse power, and the Plants conceived the idea of forging carriage bolts entirely by machinery. This they at once proceeded to put into practical execution by employing Mr. Chauncy Clark, of the American Bed Screw Company of New Britain, Conn., to supervise the construction of a machine designed to head carriage bolts under their direction. This machine was a reconstruction of the bed-screw forging machine invented by Hiram M. Clark in 1850. When completed, it was hauled to Plantsville in a two-wheeled ox-cart by Mr. Hod Carter, in the early spring of the following year. Its arrival attracted great attention in the village. One would imagine that "the greatest show on earth" had suddenly put in an appearance. Many were the excited discussions pro-

voked as to its future use and success. The construction of this machine almost baffles description. The principles involved, however, contained the germ which in a few years developed into machines that completely revolutionized all previous methods of heading or hot forging the heads on bolts. A comparison to the machines of to-day that have grown from this first machine would be like comparing a canal boat to one of those majestic steamships that plow through 3,000 miles of ocean in the short space of six days or less, or with Stephens' rocket locomotive to the mighty iron horse that flies across the continent with the speed of the wind. The machine was set up in an outbuilding formerly used as a coal shed. It was fitted up for its reception in such a manner as to prevent the curious from seeing what was being done within. Mr. Erastus W. Pierce, a skillful mechanic, accustomed to bed screw forging machines, coming from New Britain, was placed in charge, with Mr. Stanly Wadsworth as helper. Imperative orders were given to allow none to enter the building unless accompanied by authority from the office. So guarded were they of this new departure that Mr. Wadsworth was discharged for showing the machine by opening a window on Sunday to an old farmer who didn't know a bolt when he saw one. While this machine as originally built was not a success, although bolts were headed on it, it furnished the knowledge and it clearly demonstrated the practicability that led to the building of the second machine, which totally eclipsed all other efforts in this direction at that date. In less than three years and for some time prior to their being burned out in 1859, six of these machines were successfully running to their full capacity, and the company was furnishing employment for some 300 men. In those days small boys were not employed in bolt and nut factories, to any extent, at least not by the Plants. Mr. Hotchkiss, who was a large-hearted, philanthropic gentleman, employed a good many old men of the village to do the light work

about the shop, such as tapping, threading and screwing on the nuts. At this time bolts were not pointed. The removal of the oil by rolling in a barrel with sawdust closed in the first thread on the end. These venerable old fellows would sit at the bench with a sharp pointed instrument and patiently pick off the injured thread and screw on the nut. The bolts were then taken to the packing room and piled by women, papered and labeled for the market.

An amusing incident occurred one morning when two bright, strapping young fellows called to apply for employment. While waiting for Mr. Hotchkiss, they peered into the factory and saw a score or more of the old men busily employed at their occupation. "Come on, Jim," said one, "there ain't no show for us; this is an old man's home."

The hard times of 1857 proved a golden opportunity for the company, it being a clear case of the survival of the fittest. Smith, Neal & Co., of Southington, succumbed to the crisis and were bought out, likewise the Miller Manufacturing Co., of Miller's Station (Queens Street), the stock of which was purchased and the shop rented. While the wheels of industry throughout the country were nearly at a standstill, the Plants were busily harvesting, inventing and improving. The upright tapping spindles, the upright tire threading spindles with revolving dies and the pointing lathe were brought out and put in operation. In 1853 the price list was again revised, a reduction being made in the smaller sizes of carriage and tire bolts, tables of many new kinds of bolts and other articles were added, cuts were introduced and the enlarged price list printed in book form. It was accepted as usual by other firms, more from necessity than choice. The ensuing year was a most eventful one, of which Mr. Plant writes as follows:

"In January, 1859, our entire works were destroyed by fire, involving a very heavy loss. Up to this time, besides running our own works, we had bought out the firm of Smith,

Neal & Co., of Southington, the stock of the Miller Manufacturing Company, rented their shop and had also closed a contract with Messrs. S. W. Sessions and Thomas H. Lamson. We afterwards bought some of the Saratoga Bolt Company's machinery. In the spring of 1859 we rebuilt our works at Plantsville, sufficient to employ our water power only. At the same time we purchased a manufacturing property in New Haven, on Grand Street, and put in a 75 horse power engine. At this place we manufactured the largest sizes of carriage bolts, to which we added bridge rods, large bolts for railroad bridges, depots, roofs, also machine bolts, coach screws, axle clips, felloe plates, plow bolts, hinges, both plate and heavy wrought, meat cutters, sausage stuffers, etc. At these works were made all our wrought cut nuts and washers, tire bolt blanks, bed screws, etc. We also manufactured revolvers for metallic cartridges, and were finishing fifty per day before being burned out in December, 1866. Plants' Manufacturing Company made a larger variety of bolts than any other concern at the time, including the different grades, viz.: Common No. 1 and Norway C. B., spring, plow, tire, stove, machine, roof, elevator, axle clips, felloe plates, rein, halter, and tug snaps, both malleable and wrought, eye bolts, hitching rings, etc. The object of carrying on part of our works in New Haven was the saving on freight of the coal used to run our furnaces, also to include the larger size bolts and other heavy goods. We employed a large force of workmen at this place."

From 1859 to 1863 Plants had nearly exclusive control of the trade in the West, when their works at Plantsville, with the exception of one building, were destroyed by fire. An engine and boiler were almost immediately set up and the machinery again made to revolve. The ruins were cleaned away and new buildings erected. In a short time the business resumed its usual activity and bustle, several Chapin heading machines were added on which carriage bolt blanks

were upset hot from round iron and headed in single grooved dies, squared straight through. Some of these bolts were made with oval heads. This is in all probability the origin of making full square bolts from round iron and also of button or oval heads. A short time prior to this the making of pinched necks, star bolts (now called common carriage) from round iron had been commenced. The full square necks were formed with dies planed straight through, either end being used for heading. It was soon found that by filing out the back ends of the grooves with a rat-tail file it improved the appearance of the bolts very much. This led to the use of the taper-pointed reamer and the chipping out of square corners at the termination of the neck, hence the name "pinch neck" bolts; thus made, they were styled the Star brand of bolts by the Plants.

The following year they were visited with another disaster. A large portion of their immense dam gave way, carrying the railway embankment with it, entailing a heavy loss to the company. Two years later, in 1866, the entire works in New Haven were burned to the ground. This somewhat discouraged the company, the manufacture of many branches of goods being discontinued. But, like Hamlet's ghost, they wouldn't down, and with true Yankee grit, following the example of Cromwell's spider, tried again. What there was left of the New Haven works was removed to Plantsville and all of their energy concentrated at this point. Fate seemed to have turned against them, for within two years after the New Haven destruction, part of their dam was again washed away, again taking the railroad bed with it. Expenses were curtailed and every available means brought into requisition to meet the losses sustained, for which many ugly words were said and a great deal of odium thrown at the Plants. The stock to considerable extent was held by farmers and people of small means. The many disasters deprived them of dividends, hence their criticisms and distrust.

In 1867 or '68 James and Luther Clark's cold upsetting machine, designed to upset blanks from the rod cold, to be headed hot, with heading machines, was put into the shop and operated by Chas. Bell. This brought about another radical change in machine made bolts by producing much finer made bolts at a largely reduced outlay in fuel and labor, in order to compete in workmanship and finish with the Oliver headed Philadelphia bolts. The heading dies were made with two grooves and the plunger die with two heads to correspond, the upset blanks being struck once in the top groove and twice in the bottom. Another important move was the doubling up of the cutting lathes by placing two lathes together side by side, and passing the belt around the pulley of both, thus driving two lathes with one belt, doing away with the labor of one employé or one-half of the labor. This brought out the double-head four jawed, geared cutting lathe. Through the constant perseverance, energy and business tact of the Plant management during the years 1869 to 1874 much was done to replace the many heavy losses previously sustained. When Richard was about to proclaim himself at the topmost round of the ladder, in 1874, that grim destroyer, fire, again swooped down and completely annihilated their entire works, machinery and all—everything. This was the last straw that broke the camel's back. Plants went out of business. They had fought a good fight for thirty-two years against a powerful competition and the two greatest elements of nature—fire and water. They had been burned out three times in Plantsville, once in New Haven, besides, being washed away by water three times. Their losses in these disasters amounted to some \$500,000 above what they received for insurance. To them in a large measure is due the success of the bolt and nut business of this country. Among other advanced improvements they were the first to paper and label bolts, to print a price list, to introduce cuts in price lists, to build and successfully operate a turning lathe which run con-

stantly by power while putting in and removing the bolts, to tap nuts with upright spindles, to point bolts with machinery, to forge bolts with machinery and to cut the threads on bolts with two or more spindles operated by gearing.

HON. AMZI PERRIN PLANT.

Hon. Amzi Perrin Plant and his brother, Ebenezer Howard Plant, were the founders of what became one of the most widely known bolt and nut establishments of the earlier days. A complete history of their many successes and discouragements, which is extremely interesting, is given in another chapter of this work.

The Plant Brothers began business, as manufacturers of hitching rings, halter snaps and other light specialties, in a small shop in a section of Southington, Conn., which became known as Plants' Corners and afterwards as Plantsville. Success attended the infant enterprise and time rewarded their well-directed efforts. After establishing a highly profitable business, they added a bolt and nut department to their works. This also prospered without interruption for a time; but only for a time, for, along with their brightening prosperity, came one discouragement, succeeding another, with such persistent regularity as to justify a suspicion that fate had determined to conquer the energetic brothers at all hazards. Fires, floods and consequent embarrassments failed, however, to quell the hardy spirit with which they contended. The Plant Brothers recognized no such word as fail. Their recurring misfortunes were courageously met and combated with an energy that won victory in the end, though their sturdy efforts may not have been as richly rewarded as they deserved to be.

Mr. Amzi Perrin Plant, the subject of this sketch, had principal charge of the business details of the company, involving duties for which he was thoroughly qualified. His



E. H. Plant

keen business sagacity and foresight, his stern integrity and his patient and hopeful disposition eminently fitted him to meet and surmount the many difficulties encountered during his long and eventful business career. He was what is commonly termed "a many sided man," for, beside being an excellent scholar and shrewd man of business, he was an originator and inventor of a number of ingenious and valuable appliances used in his line of manufacture. Among Mr. Plant's inventions, that were patented, were the following: A machine for forging nuts, patented June 23, 1868; an ingenious tool device for turning bolt heads, patented June 8, 1869.

Though never conspicuous in political affairs, Mr. Plant was alive to all matters of public moment, and though unsought, he was honored with an election to the State Senate, where he served with the utmost credit.

As a churchman, Mr. Plant was a faithful and widely useful member of the Baptist Society and Church, and a cheerful and liberal contributor to all undertakings to promote and extend the blessings of religious faith.

Mr. Plant was born in Southington, in 1816, and died at Plantsville, July 21, 1874.

EBENEZER HOWARD PLANT.

Mr. Ebenezer Howard Plant shared with his brother, Amzi Perrin Plant, in building up the extensive manufacturing enterprise of The Plant Manufacturing Company, as well as in the many vicissitudes encountered in their various business undertakings. The two brothers were similarly constituted in almost every respect. Both were tireless workers, persevering and buoyant-spirited under all circumstances, and neither ever thought of repining even during the darkest days of their eventful business career. Both were endowed with

clever mechanical genius and business tact, both of which they employed to excellent advantage. Among Mr. E. H. Plant's inventions were the following:

A device for attaching thills to carriages, patented September 1, 1860; for straightening and forming clips, patented July 19, 1870; a die for screw-eye bolts, patented September 12, 1871; a die for making carriage bolts, patented March 18, 1873.

Although deeply engrossed, and often overtaxed by the perplexity of his business affairs, Mr. Plant never neglected his duties to The Supreme Ruler, nor to his fellow man. In public affairs he held aloof from politics, but was always active in promoting measures that would tend to the general welfare. It was due to Mr. Plant's efforts that a railroad station was located at Plantsville, a public improvement that gave a decided impetus to business in the locality and resulted in creating a prosperous manufacturing center of considerable note.

Mr. Plant was a man of earnest piety and an active and widely useful member of the Baptist Church and society. His leisure hours were chiefly devoted to literary pursuits, his taste in this direction inclining to works of a religious character. One of his most noteworthy achievements in letters was the authorship of a carefully prepared and accurate Baptist Manual extending back to the year 1738.

Mr. Plant's beautiful residence serves as a picturesque landmark to Plantsville. It is situated on the summit of the loftiest rise of ground in the section and commands a wide, panoramic view of the charming landscape surrounding it. The spacious grounds are tastefully adorned, and near by is a tall shaft, known as Plant's Tower, which serves the double purpose of an observatory and a conspicuous landmark that can be seen for a distance of many miles.

Mr. Plant was born in Southington, February 25, 1821. His death occurred at his home in Plantsville, January 12, 1891.

BRISTOL AND GRACE.
Southington.

During the year 1841, Stephen Grace, a blacksmith of Southington, Conn., brought out his solid die, reversing thread cutting lathe, which so closely resembled the Martin Barnes lathe that experts pronounced it a twin brother, although it differed in certain minor details. It was operated by a crossed and a straight belt and three pulleys, the center one being solidly keyed to the shaft. The front end of the spindle carried the die, and to the rear end was attached a tail screw, working in hard wood boxes, which forced the shaft endwise to engage the die with the blank, in cutting the thread on the bolt, which was held stationary. When the thread was cut to the required length, the lathe was reversed with a shifter, operated by a foot treadle, and backed off to complete the work. Grace's name was entirely in keeping with his habitual deportment. Though a common village blacksmith, his courtly manners earned for him the title of "the polite blacksmith," and while some of the village wags declared that he had "licked the Blarney stone," others styled him the "strut Irishman." He was a good mechanic and a man of considerable genius, nevertheless, and the fact that he developed his new machine and made it the foundation of a manufacturing establishment, denotes that he was not wholly destitute of business sagacity.

In 1842, Captain Julius Bristol, a highly respected and well-to-do farmer of the town of Southington, formed a co-partnership with Mr. Grace and furnished sufficient capital to equip a bolt works, at what is now known as Milldale, on the Quinnipiac River, and at the point now occupied by the works of Clark Brothers Bolt Co. The firm was known as Bristol & Grace. The machinery was of the primitive type and most of the work was done by hand.

The venture did not prove very profitable to Mr. Bristol,

and the partners dissolved and gave up the bolt business in 1843, after about one year's experience. Mr. Bristol resumed farming, and Mr. Grace found employment at his trade (blacksmithing), which he continued to follow contentedly and "politely" the remainder of his life.

BOLT AND NUT BUSINESS OF CAPT. JULIUS BRISTOL.

Southington.

Mr. Bristol's rather unsatisfactory experience in the bolt business seemed to have aroused in him a desire to try again, for we find him, two years later, buying up a lot of old saw mill property and water rights in "South End," situated in the southeast corner of Southington, on what is called Misery Brook. Captain Julius Bristol, "farmer-capitalist," heretofore mentioned, while not of a mechanical turn of mind himself, but perhaps of the sort of our modern "Carnegie" type, whose greatness did not consist in what he knew himself, but in knowing enough to place others around him who knew more than he. In this way, after he had got his shop and water power in South End, which was in 1845, he employed the best blacksmiths and mechanics obtainable, depending on them to tell him how, and started to manufacture nuts and bolts. He was uniformly successful, and little by little built up a large business for those days. His methods of production and employment seem to have been almost wholly by contract. To illustrate, his nut business, which was plain cold pressed nuts, was let out to be made by one Chas. A. Mathews, who at the time (1846) was considered an expert with a nut press. It was understood, of course, that the nuts were made in Bristol's shop, and that Bristol furnished the stock, tools, power, etc., but that Mathews devised the method of manufacture and did all the work or caused it to be done. Besides having nuts made for himself, he (Bristol) sold nuts outside to other bolt makers.

In this connection, with contract work, there is one instance which is quite interesting. In about the year 1847, Mr. Bristol employed and contracted with Burdette Smith, of South End, a blacksmith or mechanic by trade, to make 200,000 tire bolts for him. The written agreement called for the job to be done within one year and Bristol obligated himself to pay Smith along from time to time as fast as he could get the bolts out, etc. Mr. Bristol had been looked upon and respected as a prudent and conservative citizen, and a person of financial and moral standing in the community. Nevertheless, when it became generally known that he was having 200,000 tire bolts made all in one year, and had obligated himself to go into the expense of such a "tremendously big" undertaking, his credit and standing was materially injured, and notwithstanding that he was a farmer of substantial means, he was looked upon for several months with considerable suspicion, as his venture was put down as a "crazy one." However, Mr. Bristol evidently knew more of the possibilities of the future than most of his critics, and succeeded in carrying out his plans to the pleasure and profit of his employés as well as to himself, and it was reported as one of his remarks on the subject that he said, "As long as I am making 200 per cent., I don't feel at all alarmed."

The price paid by Bristol for threading bolts by hand in those earlier days was 35 cents net per 100.

BRISTOL, MOSS & CO.
Southington.

Early in 1851, Mr. Bristol decided to increase his business, and took in as partners Aaron Moss and Romeo Lowrey, both substantial farmers, forming the company known as Bristol, Moss & Co., of South End. He deeded these investors an undivided half interest in his mill property and business. Mr.

Moss, while not a mechanic, knew something of the bolt business, as he had been a partner in the Frost company from 1848 to the time of his association with Mr. Bristol, but Mr. Lowrey knew nothing about the business and took no active part in it. He simply became connected with Bristol, Moss & Co., as an investment.

Dropping the nut business, they continued to make bolts until 1853, when they were bought out by the Plants, which ended their career in the bolt industry, having enjoyed a healthy and profitable growth, notwithstanding that their plant at South End was several miles from any railroad, canal or city.

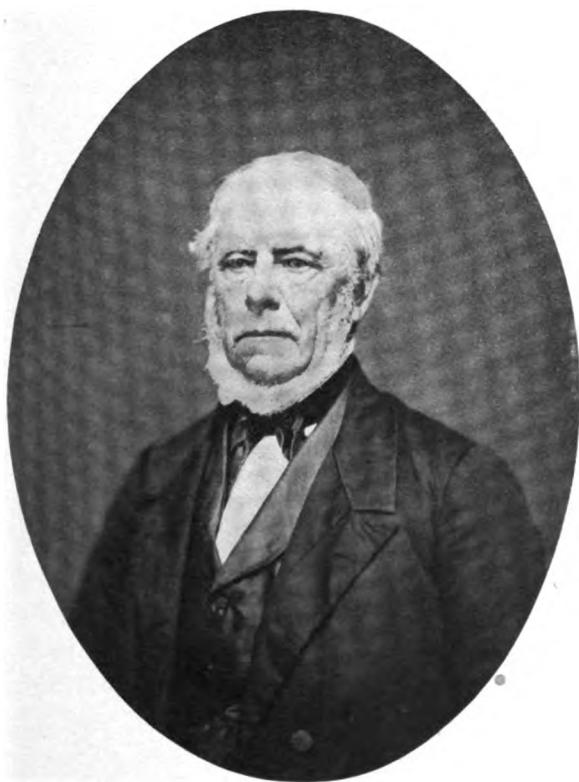
CHARLES A. MATHEWS. **Southington.**

At the time (February, 1851) that Captain Julius Bristol took in Aaron Moss and Romeo Lowrey as partners, he sold out his cold pressed nut business to Chas. A. Mathews, who ran this business only a short time, as Mr. Mathews died the following May, and the nut business was then bought by Captain J. B. Savage. Mr. Mathews was previously employed by Mr. Bristol as his nut maker, holding the contract up to the time the above change was made.

In later years Mr. Bristol became interested in The Plant Manufacturing Co., of Plantsville, The Peck, Smith & Co., afterwards Peck, Stow & Wilcox, and was recognized as one of the most prominent manufacturers in the town of Southington.

CAPT. JULIUS BRISTOL.

Captain Julius Bristol was born in Hamden, Conn., August 11, 1793, and died in Southington, Conn., April 13, 1876.



Julius Bristol

The greater portion of his life was spent in the south-eastern section of Southington, known as the "South End," where he was engaged both in farming and manufacturing and where he was one of the earliest to engage in the manufacture of carriage bolts.

In 1842 Mr. Bristol formed a co-partnership with Stephen Grace and established the firm of Bristol & Grace. After about one year of unprofitable experience Mr. Bristol gave up the business and again applied himself to farming. In 1845 Mr. Bristol purchased mill privileges in the South End and in company with his son, J. D. Bristol, resumed manufacturing carriage bolts, under the style of J. Bristol & Son. In later years he formed the co-partnership of Bristol, Moss & Co., who sold out to the Plant Manufacturing Co., at which time he became associated with the latter company. He also became interested in the Peck, Smith Co., of Southington, which subsequently became the Peck, Stow & Wilcox Co., of which he was made president.

Although Mr. Bristol was reared on a farm and had few advantages in the way of mechanical training, his rare executive ability and foresight enabled him to organize and conduct a number of manufacturing enterprises that were both prosperous and profitable.

Many attempts to lure Mr. Bristol into the political arena proved unsuccessful. Nevertheless, he was always alive to matters of public interest and active in promoting general improvements. Bristol Street, one of the main thoroughfares in Southington, was named for him and it was through his instrumentality that it was laid out and improved. Mr. Bristol was also active in promoting many other public improvements that contributed to the growth and progress of Southington.

Mr. Bristol's reverence for the brotherhood of mankind induced him to affiliate with the Masonic fraternity, of which he became a conspicuous and widely useful member. In all

of his business, public and social relations, Mr. Bristol earned and enjoyed the confidence and respect of his contemporaries. At his death, his entire business affairs were assumed and successfully continued by his son, J. D. Bristol, until his death, which occurred August 29, 1884. Following in the footsteps of his worthy father, Mr. Julius D. Bristol left behind him a record of sterling business ability, progressive enterprise and recognized integrity and worth.

The only surviving member to perpetuate the name of the large Bristol family is Mr. George D. Bristol, grandson of Captain Julius Bristol, who is one of Southington's well-known and most highly respected citizens. Also Marcellus B. Wilcox, a grandson of Captain Bristol, who is at present the managing spirit in the Peck, Stow & Wilcox Co., and a man of unusual prominence and ability in connection with the business growth of Southington.

BABCOCK & BRADLEY.
New Haven.

In 1842, the carriage makers of New Haven, Conn., were so extensively engaged in building vehicles of various kinds for the Southern market that an unusual demand for carriage bolts was created in the city, a circumstance that induced two enterprising blacksmiths, William Babcock and Hiram Bradley, to undertake to supply bolts to several carriage builders by contract. They occupied a small shop on Chestnut Street, and their work was wholly performed by manual labor. They gradually increased their plant and did a very prosperous business, until it fell to their fate to be numbered among the victims of the panic of 1847. A large wooden carriage bolt, inscribed "Babcock & Bradley," which adorned the front of their little factory, was removed in 1848, and, together with the tools, was sold to Chandler & Rewell P. Cowles, doing business as C. Cowles & Co.

After settling the affairs of the firm, Mr. Babcock resumed business in a small way, occupying the same building until 1879, when he rented half of the building, with steam power, to Bradnack & Leonard. Mr. Babcock's business during this period was confined to manufacturing small forgings for carriage work.

THE MILLER MANUFACTURING COMPANY.

Southington.

In 1843 Mr. Anson Merriman commenced bolt making on the mountains east of Southington, in a small section of Southington Township known as Flanders, near Shuttle Meadow Lake. Horse power was employed to run the crude machinery and the product was necessarily small. The average cost of production was \$18 per 1,000 5-16 carriage bolts, rated according to the trade regulation of the period.

In 1848 Mr. Merriman sold his business to his son, Lewis Merriman, and Jonathan T. Hart, who removed the works to Kensington, township of Berlin, Conn., where they increased their facilities to some extent. About a year later Mr. Hart sold his interest to Mr. Merriman, who entered into partnership with H. A. Miller, under the firm of Miller & Merriman. Previous to this Mr. Miller had been engaged in manufacturing wooden and metal clock dials, fire shovels, tongs, cranes and andirons (used in those days in fireplaces for cooking and heating, now made extremely ornamental and styled parlor fire sets), at Miller's Station, a place named after him, on the canal railroad and Queen Street, between Southington Center and Plainville. According to local tradition, Queen Street was indebted for its name to a very disreputable old half-breed squaw, whose bravery in the way of dress and manners and utter contempt for soap and water and everything that would contribute to cleanliness, earned for her, among the early settlers, the title of "The Queen." Mr.

Miller's business dated back as far as 1837. To these works Mr. Merriman moved his machinery. Miller and Merriman devoted their whole time to bolt and nut making, employing about twelve men and turning out daily some 2,500 finished carriage bolts. Their mode of manufacture was of the Barnes method, except rounding, which was done with a wooden beam trip hammer. The bolts were headed by hand. This was the second bolt and nut factory in America driven by steam.

Two years later (1850) Mr. Miller purchased the interest of Mr. Merriman and continued the business until 1853, when a joint stock company was formed under the name of The Miller Manufacturing Co., with H. A. Miller as president, Joseph Gridley vice president, and S. W. Sessions secretary and treasurer. The principal stockholders were H. A. Miller, Joseph Gridley, E. Howard Plant, A. Perrin Plant, George Dunham, Captain Julius B. Savage, Thomas H. Lamson, S. W. Sessions and I. P. Lamson. Their facilities were gradually enlarged, and the best methods and improved machinery of the early days were used. Eight rounding presses, twelve hand headers and six hammer turning lathes were kept constantly at work, furnishing steady employment to forty persons and producing daily an output of about 10,000 carriage bolts. About this time (1853) the open die spring jaw threading lathe was originated and was first used in this factory. It was built by John Curtis, of Southington Center. It had two jaws connected with links at their back ends to a sliding sleeve, which was tripped in a similar manner to the four jawed cone lathes of the present day. At a later date the third jaw was added and afterwards the fourth.

There is a question as to who applied the cone, several parties claiming the credit. Mr. Barnes credits the invention to Mr. Curtis, who, at all events, was the first builder and who undoubtedly made many improvements on the then valuable machine.

A typical case of trade trafficking, so frequently resorted to, on account of the scarcity of currency, occurred while Mr. Miller was in company with Mr. Merriman. He was offered a considerable number of Wade & Butcher razors, in exchange for bolts, nuts and other commodities, and, as it was what he called "a ground hog case," he must either take the razors or lose the sale, he accepted the proposition. He had no idea how he could turn such a stock of razors into cash, but he soon solved the problem by offering each of his employés one razor for one day's work, and by this means he finally succeeded in disposing of his entire stock at a fair profit.

The following was told by the late S. W. Sessions of his old friend Sam Frisbie, afterwards secretary and treasurer of the Upson Nut Co., Unionville, who was turning bolt heads in the shop one day, when his old friend and teacher, Prof. Day, superintendent of the High School at Southington, dropped in to feast his eyes on the wonderful machinery. The professor became greatly interested in the bolt head Sam was manipulating, but failed to recognize the operator for some little time. Observing this, Sam roguishly shifted his position so often as to make it extremely difficult for the professor to get a satisfactory view of the operation. When Sam shifted, the professor did likewise, and Sam would shift again. This little game of hide and seek had proceeded for some time, when the professor stopped, and with an amused smile of recognition, said, "Well, Sam, I am anxious to know about how many of those things you can peel in a day." The professor's query became a by-word among the boys in the factory.

The panic of 1857 proved fatally disastrous to the once promising undertaking. The stockholders and their friends battled manfully to stem the opposing tide, but their efforts failed and a complete financial wreck ensued.

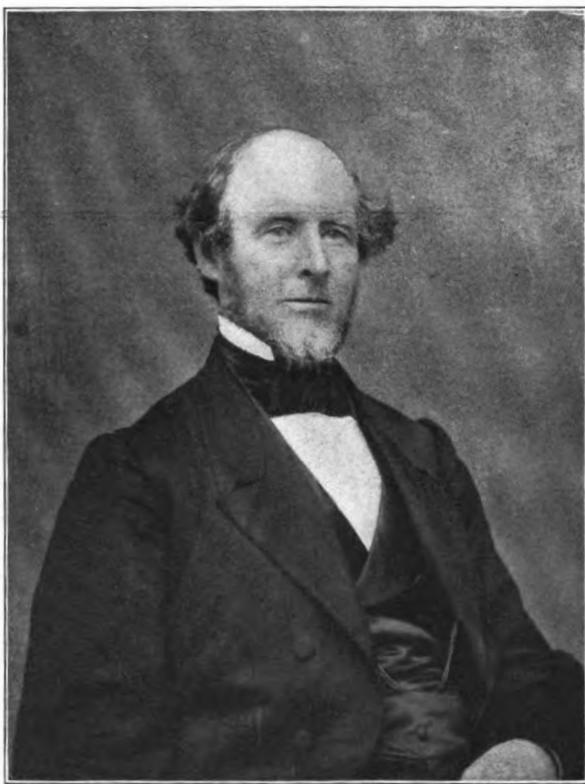
Subsequently Thomas H. Lamson and S. W. Sessions took charge of the business and made bolts by contract for

the Plant Manufacturing Co. At the expiration of the first year under this arrangement, Mr. Lamson retired. Mr. Sessions continued another year, at which time the entire plant, including buildings, stock and part of the machinery, was sold at auction to J. B. Savage, of Southington Center, for \$1,350. The buildings were moved on cars to Southington Center and the main building was utilized as an office by Mr. Savage up to a recent date. A portion of the tools were sold to Messrs. Chandler & Rewell P. Cowles, of New Haven, through Martin Barnes, and most of the machinery was sold to The Plant Manufacturing Co. The railroad station was removed; the hands employed sought other centers of industry, and little now remains of the once busy center except the "Old Dunham Tavern," a few farm houses and the giant elms that adorned the landscape. It should be added that the stockholders finally received a dividend of six per cent. on their investment.

"The stoutest ship may breast the gale
And still be driven back;
What though to reach the port she fail,
Shall we declare she could not sail
Because she had to tack?"

Although the promising venture proved a most disastrous and discouraging failure, it may be said to have been a beneficent educator. Nearly every person prominently connected with the enterprise, so richly profited by his experience that he won success in after years and became recognized as a leader in financial and manufacturing circles.

The directors were H. A. Miller, Captain Julius B. Savage, S. W. Sessions, Joseph Gridley and A. Perrin Plant.



H. A. Miller

HENRY A. MILLER.

Henry A. Miller was born at Southold, Long Island, July 2, 1810. Ten years later his family removed to Atwater, Portage County, Ohio, where they made but a brief sojourn, and returned to the East, permanently locating in Meriden, Conn.

After completing his schooling, young Miller learned the art of clock making and mastered the profession so thoroughly that he was engaged as an expert to visit Montreal, Canada, and establish a clock factory in that city. After a few years spent in the queen's dominions, Mr. Miller returned to Connecticut, and established himself in the clock making business in the North End of Southington, the town which early became an important center of the bolt and nut industry.

On June 15, 1835, Mr. Miller was married to Miss Charlotte Deming and took charge of the management of the Deming farm, of 150 acres, situated on Queen Street. He also removed his clock factory to the farm, and adding necessary equipments, engaged extensively in manufacturing clock dials for the general market, employing from twelve to fifteen workmen, and finding a ready market for his product among the various manufacturers of clocks. In the course of time, however, the clock manufacturers, seeing considerable profit in making their own dials, withdrew so much of their patronage from Mr. Miller that he abandoned this branch of trade and for a time devoted his entire attention to the management of his farm.

In 1848 Mr. Miller and Mr. Lewis Merriman organized the firm of Miller & Merriman and built a factory at what was afterwards known as Miller's Station on the New Haven and North Hampton Railroad, where they engaged in manufacturing carriage bolts, brass shovels, tongs and other articles, making a specialty of the bolt business. This co-partnership was dissolved in 1850. Soon after the dissolution

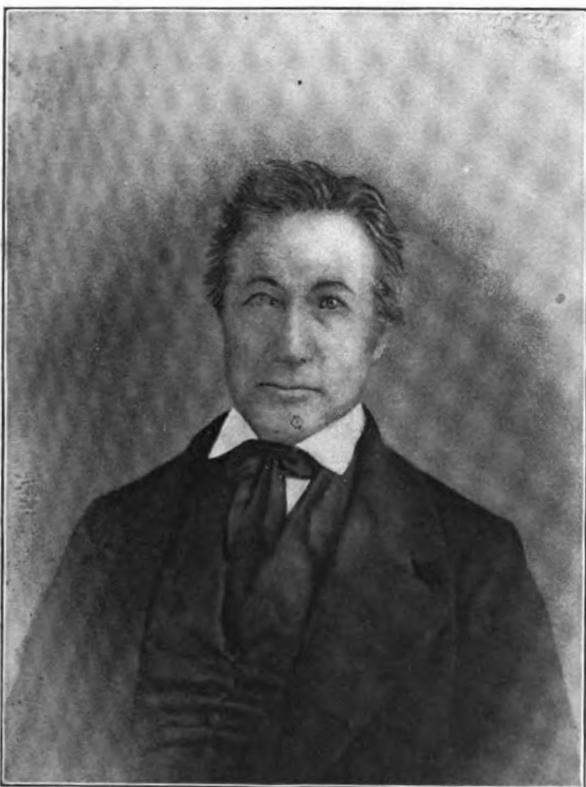
Mr. Merriman took up his residence in the western country, and during a very severe winter he perished in a heavy snow storm, and his frozen remains were found on the prairie a short distance from his home. The Miller Manufacturing Co. became successor to Miller & Merriman, with Mr. Miller as president and general manager. Its specialty was carriage bolts and nuts produced by the earlier methods. After continuing in business a few years the factory was closed and the buildings and machinery were sold and removed to Southington, divesting Miller's Station of everything but its name and its solitude. Where the whistle had been wont to awaken the echoes of the valley with the summons to labor, silence reigned as the bees quietly sipped the sweets from the blossoms and the kine contentedly cropped the herbage that covered the site of the once bustling little scene of industry.

In addition to his farming interests, Mr. Miller was interested in other business enterprises that were successfully managed and proved highly profitable. Mr. Miller leased his farm and retired from business in 1876, at which time he removed to Plainville, Conn., where he resided until his death, which occurred April 6, 1888.

Though not a native of Connecticut, Mr. Miller's entire business life was spent in that commonwealth. He was shrewd, careful and strictly honorable in the transaction of his business affairs, and, although he met with reverses, his recuperative energies and industry enabled him to overcome all obstacles to ultimate success. His later years of retirement were spent in a quiet home at Plainville, where he enjoyed the friendship and companionship of his neighbors and the esteem and good will of all of his fellow townsmen.

ANSON MERRIMAN.

The following is an excellent portrait of Anson Merriman, one of the little group of "Connecticut Yankees," who seemed,



Amerson Morrison

almost intuitively, to grasp the idea that the manufacturing of carriage bolts for the trade could be made a profitable business.

Mr. Merriman was born in Southington, Conn., October 21, 1786. After serving his time as a general mechanic, he engaged in manufacturing a variety of small articles, such as brass combs, buttons wound with silk (the first made in this country), hames, tongs, brooms and Yankee notions generally, doing a very prosperous business in his several lines. Later on he decided to try farming and fruit raising, and accordingly purchased what is now known as the Gad Andrews farm. This property has two claims to local prominence. During the Revolutionary period it was the site of a popular roadside tavern and station for the stages, being one of the best known hostleries between Weathersfield and the Farmington Valley. Soon after taking possession of the premises, in 1824, Mr. Merriman discovered a species of stone on the farm which he believed could be converted into a superior quality of cement. Rigging a crude furnace, he began experimenting, much to the amusement of inquisitive neighbors, who ridiculed the idea and voted him a visionary. Nevertheless, Mr. Merriman soon proved that his theory was correct, and immediately began preparing the material in small quantities, taking it to Kensington to have it ground at More's factory. This was the first cement ever produced in Connecticut and probably the first in the country, but for some reason Mr. Merriman abandoned the promising enterprise and sold the productive farm. Soon after he purchased the farm on High Rock Mountain, now occupied by his son, Josiah Merriman, in Southington, where he extensively engaged in cultivating fruit, and making a specialty of Baldwin apples. On this farm he also erected a work shop and began manufacturing carriage bolts, in 1843. A detailed account of Mr. Merriman's other ventures in the bolt business will be found in another chapter of this work.

As implied in the foregoing, Mr. Merriman's genius covered a broad range and was ever seeking new fields to conquer. He was a man of tireless energy and perseverance, and he met with notable success in his various undertakings. Mr. Merriman died September 2, 1853.

GUSTAVE SCHMITT.

Westville.

In 1845, Gustave Schmitt began manufacturing carriage bolts by hand in a little blacksmithing shop in Westville, Conn. His work was done in a very small way in connection with general jobbing. He closed out his business in 1858.

JOSEPH BUCKLEY.

Westville.

Two years later, 1860, the place was occupied by Joseph Buckley, who also began manufacturing bolts and axle clips. His bolts were headed by hand, but the blanks were rounded by a Barnes rounding press. He continued in business until after the close of the civil war, when the decline in prices rendered it unprofitable, and he finally suspended in 1866.

BOLT AND NUT BUSINESS OF CAPT. JULIUS B. SAVAGE.

Southington.

In 1844, Captain Julius B. Savage, Connecticut's pioneer manufacturer of cold punched nuts, for the trade, began manufacturing rough, unfinished, cold pressed nuts, originally called "wrought cut" nuts, for carriage bolts, in a small shop in a section of Southington Township, Conn., known as the South

End. He employed a power press, said to be the first ever used for the purpose in the State. His first order was for 50 lbs. 5-16 nuts, bolt size, from Anson Merriman, a neighboring bolt maker, for which he received \$6, attested by receipt for same in possession of the writer.

In 1849, he removed to the old carding factory on the Quinnipiac River, about midway between Plants Corners and Dickermans Corners, now known as Milldale, and on the site now occupied by Clark Brothers Bolt Co. He increased his machinery by purchasing two Allen and Atkins presses.

In 1851, Mr. Savage removed to Plant's Corners, again increasing his machinery and occupying a building owned by A. P. Plant & Co., for whom he contracted to furnish nearly the entire product of his factory, consisting of carriage, bridge rod and other nuts and washers. At the expiration of this contract (1858) he sold his machinery to the Plant Manufacturing Co. During the year (1851) Mr. Savage also bought the machinery of Charles A. Mathews, of South End, who formerly manufactured nuts for Bristol, Moss & Co. This he removed to John H. Hobart's foundry and machine shop, on Dog Lane, back of the North Center School House, Southington, Conn., where he manufactured cold pressed nuts for the market. Here he employed Adolph Frienck, an ingenious German mechanic, to reconstruct a bolt heading machine, invented by him and built by Taylor & Whiting, of Winsted, Conn., and also to build a nut forging machine after Mr. Savage's ideas, on which he displayed considerable ingenuity. Neither of these devices proved entirely successful. The nut machine was utilized to some extent, but the bolt machine proved an utter failure, although it possessed valuable mechanical ideas that were afterwards successfully developed. The nut machine was patented by Mr. Savage, however, December 14, 1858, and eventually passed into the possession of the Union Nut Co., of Unionville, Conn.

In 1859, Mr. Savage sold his entire cold nut machinery at Dog Lane to Mr. Dwight Langdon, of Unionville, Conn., and at once began the erection of a new factory building on Railroad Avenue, south of The Peck, Smith & Co.'s works, Southington, where he established machinery for the manufacture of carriage bolts of various styles and sizes. Shortly previous to this, however, he had purchased the buildings abandoned by The Miller Bolt Manufacturing Co., at Miller's Station, Conn., intending to locate his factory at that point, where a portion of his machinery had been shipped, when he decided to locate at Southington, whence the entire buildings were afterwards removed and added to his new plant.

At this factory, in 1868, James B. Clark introduced the first machine invented for upsetting carriage bolt blanks cold from the round rod to be headed on a heading machine, hot, making a full square, in one groove, with two strokes of the machine. Mr. Thomas Martin was the first to operate this machine and introduce an entirely new and original process. The dies of the heading machine proved defective, however, on account of producing imperfect squares. The upsetting machine was therefore removed to the works of The Plant Manufacturing Co., where the process was perfected by introducing a second plunger die, and a corresponding groove in the heading dies, by which means clean, smooth, full squares were produced which were free from cold shuts or fins. They were formed by three strokes of the heading machine, one in the upper and two in the lower grooves, the bolt being shifted, with a turn, for each stroke.

In 1868, Mr. Savage disposed of his entire business and machinery to Messrs. Franklin Bradley and Averisto L. Lewis, who removed the machinery to Cleveland, Ohio, and established the firm of Bradley & Lewis under the style of The Cleveland Norway Bolt Co.

A few months later Mr. Savage embarked in the manufacture of carriage hardware. In 1893 he closed his factory,



D. B. Denney

selling his building to Peck, Stow & Wilcox, and his machinery to The Scranton Forge Co., of Scranton, Pa., and retired from business.

Mr. Savage was a man of the stanch old New England type, whose word was as good as his bond, and he enjoyed the confidence and good will of all with whom he had dealings. He dealt with his many employés in such a spirit of liberality and kindness that he was always regarded by them with the highest respect and warmest affection.

A portion of Mr. Savage's old "Dog Lane" factory still remains as a relic of his early business career. The frame portion of the structure was destroyed by fire soon after being vacated by Mr. Savage, but the main building, of brick, is still standing and is now used as a cow stable.

CAPT. JULIUS B. SAVAGE.

"He was a thoroughgoing, successful and exemplary business man, of the old school." This brief paragraph has often been employed to serve as a panegyric and as the summing up of the noble character of men of rare genius and ability, whose lives have been characterized by earnest and industrious effort, strict integrity, broad and comprehensive humanity, a devotion to the public welfare and eventually rounded out by the notable success of all their undertakings. We have therefore chosen it to express an honest estimate of the worthy character of Capt. Julius B. Savage, who was a conspicuous pioneer and promoter of the great bolt and nut manufacturing industry of America.

Capt. Savage embarked in the manufacture of cold pressed nuts for bolts in the south part of Southington, Conn., in 1844, having purchased as he claimed one of the first Atkins and Allen presses ever constructed and the first ever used for the purpose in his State. His earliest sale was made to Anson Merriman, who was making bolts on his farm near

Shuttle Meadow Lake, in a small way, and employing horse power to propel his machinery. A detailed account of Mr. Savage's manufacturing and business enterprises is presented in another portion of this work.

Mr. Savage invented and patented a number of valuable and useful devices and improvements that shared in the development of the bolt and nut, and also the carriage hardware industry, in which he was also engaged.

During his many years of active business life, Capt. Savage never forgot nor failed to recognize that he owed certain duties to the public. He had a distaste for politics, under the usual acceptation of the term, but, nevertheless, he never shirked a public call or responsibility. Between the years of 1852 and 1882, he was ten times chosen by his fellow-citizens on the Democratic ticket to represent them in the State Assembly. He also served as selectman of the township and was honored with public trust in other ways. He served as president of the Southington Water Co., and was a director of the Peck, Stow & Wilcox Co. All in all, Capt. Savage led a busy, exemplary and useful life.

Julius B. Savage was born on East Street, Southington, Conn., June 1, 1817. He died at his home in Southington Center, August 27, 1894, aged 77 years.

AMI SACKETT AND SHARON BASSETT.
Bolt Manufacture in Birmingham and Shelton.

The early history of the bolt and nut business in the thrifty manufacturing center of Birmingham, Conn., affords an interesting example of the trials and tribulations encountered by so many of the earlier ventures into this seductive field of activity.

During the earlier part of the year 1848, Ami Sackett, an inventive genius and a general mechanic, began making spring bolts, in his small shop at North Haven, Conn, where he had been engaged in general blacksmithing since 1838. For the purpose of expediting the work and economizing in labor, he constructed with his own hands, a rude device for employing horse power. The machine was a unique affair, almost wholly composed of wood. It consisted, mainly, of a huge vertical timber shaft, to the upper end of which was attached a ponderous wooden bevel-gear wheel, which transmitted the power to a horizontal main shaft by connecting with a small bevel pinion gear. A long sweep was attached to the upright shaft, and its outer end was provided with a framework, so constructed as to form a breast yoke for a horse to push against to propel the shaft as he circled around it.

In 1851, Mr. Sackett dispensed with horse power, substituting water power in its stead. This he did by employing his own handiwork in building a wooden turbine water wheel, which proved entirely satisfactory and operated to excellent advantage.

Mr. Sackett was the first to make and introduce to the market, large headed bolts, for the ends of springs, known as end spring bolts, which he manufactured in a small way, personally making the sales and delivering them to his few customers in a leather traveling bag.

In 1851, after nearly three years of anything but satisfactory experience in the bolt and nut business, Mr. Sackett formed a co-partnership with Mr. Sharon Bassett, of the same village, under the style of Sackett & Bassett. Up to this time, Mr. Bassett had been a village shoemaker, cobbler and "mender of soles." He was a kind-hearted, amiable man, not unlike Tam O'Shanter's trusty crony, "Souter Johnnie," perhaps, for he loved good stories, was a most agreeable companion, and in later years, after he had proved himself a man

of keen business instincts and had become prosperous, he greatly enjoyed recounting to his employés and others, the trials of his earlier business life.

The existence of the firm of Sackett & Bassett was of brief duration. It was soon discovered that a business that had provided so sparingly for one could hardly be depended upon to yield profit for two, and hence the business was discontinued at the expiration of a few months.

Soon afterwards, Mr. Bassett made a proposition to purchase the interest of Mr. Sackett, which was promptly accepted. Sackett was to receive the princely sum of two dollars and fifty cents for his interest in what was left of the concern, with the proviso that Bassett should give him steady employment at a salary of one dollar per day, and the presumption is that Sackett agreed not to strike for higher wages.

Such articles as were worth the cartage were immediately removed to Birmingham, where Mr. Bassett began to lay the foundation for his successful business career. Things did not move smoothly from the beginning, however. His factory was located on Main Street, opposite the old rolling mill, and the power was furnished by what was termed "surplus water," meaning the overplus not used by other manufacturers, who controlled the entire water power of the town, and who were classed as "permanent water users." On this account Mr. Bassett was frequently forced to suspend operations during dry seasons of the year. A considerable quantity of machinery and tools was needed to properly equip the factory and there were many minor obstacles, all of which Mr. Bassett successfully surmounted in due time.

As soon as his factory was systematically arranged, Mr. Bassett employed three expert bolt makers from Philadelphia, who had mastered the trade in the employ of the Colemans. One of these, Mr. Thomas McGinniss, introduced the Oliver header, and Dennis Daly and Patrick Keith, who made nuts by hand.

Mr. Keith, who is still in the harness at Cleveland, relates that once, while employed by Bassett, he accepted a wheelbarrow load of large blue packages of "Mrs. Miller's" smoking tobacco, called at that time "Undertaker's Delight," in lieu of money for his week's wages, and that he traded it for his board and other necessities to good advantage.

Mr. Bassett's most notable and valuable achievement was, undoubtedly, that of introducing the eccentric head spring bolt, which gained immediate popularity, and eventually superseded every other style of end spring bolts in the markets of the world. It also materially advanced the bolt industry and rapidly built up the fortune of its originator. The result was attained by modifying the style of bolt manufactured by his old partner, Mr. Sackett. Although it seemed a very simple matter to change the head of a bolt to one side, this apparently trifling change proved to be the key to Mr. Bassett's immediate success in the bolt and nut business.

In 1872, Mr. Bassett united with a number of other manufacturers in building an extensive dam across the Housatonic River just above Birmingham, which was completed in 1874, thus creating an enormous water power on the west bank of the river formerly called Huntington, but since changed to Shelton. To this place Mr. Bassett removed his factory, where it was carried on by his son, Mr. Dickerman N. Bassett.

When visited by the writer in 1887 Mr. Bassett's factory was equipped with the most modern machinery, including two Farrell Foundry & Machine Company's make of upsetters (stavers), and a number of machines designed by Mr. D. N. Bassett himself. The construction and finish of these various machines were suggestive of careful and accurate construction, and the most artistic designing and finish. A peculiarly noticeable feature of Mr. Bassett's method of manufacture was the simple manner of tapping small nuts. For example, $\frac{1}{4}$ inch bolt size, the tap shanks, 6 or 7 inches long, with a threaded and fluted portion, $3\frac{1}{2}$ or 4 inches in length, tapering very

slightly towards the point or small end, the threaded portion revolved in a square, open top horizontal steel box, or nut holding trough; the nuts were fed into the end, one at a time, by hand, so as to always allow a few vacant threads on the tap, between each nut. In this manner from four to six nuts were being threaded by following each other on the tap at one and the same time. The idea suggested to the writer that the method might be fittingly called the "tandem tapping system." In other respects the machine differed in no particular from other horizontal tapping spindles; the tap shanks, when full, required to be removed and emptied in the usual manner. By this process small nuts were tapped with great rapidity, 20,000 per day being a general average for two taps, fed by one operator. In 1894 Mr. Bassett discarded his Olivers and substituted drops for bolt head forging, which, under Mr. Bassett's supervision, proved very successful. Oil fuel was also introduced with satisfactory results; this was used with high pressure. Mr. Bassett died during the summer of 1904, and the business is still conducted by his office management.

THE SHELTON COMPANY.

In 1855, Mr. Edward N. Shelton established a very successful bolt and nut business in Birmingham in connection with his nail business, founded in 1836. For a number of years he was an exclusive manufacturer of carriage bolts, and he was probably the first to make a specialty of skein bolts and introduce them to the general trade. He also at one time manufactured coach screws in small quantities. Subsequently he added other branches to his business, including carpet tacks, etc., which branch has very nearly eliminated the bolt business. This firm is still using square iron, rolling the round cold, on the small sizes, and hot on the 7-16 and $\frac{1}{2}$ inch, doing most of the heading with drop hammers, although some hand head-

ing is yet in vogue. Mr. Shelton was very enterprising and public-spirited and it was largely due to his efforts that the large dam on the Housatonic, above Birmingham, was built. After the dam was constructed and the little settlement of Huntington, on the west side of the river, began to show signs of becoming a prominent manufacturing center, the name of the place was changed to Shelton, in honor of Mr. Shelton, who was recognized as one of the largest contributors to its growth and prosperity. Immediately after the dam improvement, in 1874, Mr. Shelton moved his establishment to Shelton, formerly Huntington, and erected one of the finest manufacturing buildings in the village. This substantial building is still occupied by the Shelton Company.

PECK, STOW & WILCOX.

Early in the '80s Peck, Stow & Wilcox began manufacturing bolts and screws, in Birmingham, establishing a very well equipped factory in the old rolling mill that had been abandoned for a number of years. Mr. Hial Grannis, of Plantsville, managed the business for a few years, but it proved unprofitable and the entire machinery and equipment was sold in February, 1887, the larger portion of it being purchased by The Lamson & Sessions Company and removed to Cleveland, Ohio.

C. COWLES & CO. New Haven.

In 1848, Messrs. Chandler and Rewell P. Cowles, manufacturers of harness and carriage trimmings on Orange Street, New Haven, established a bolt and nut works under the title of C. Cowles & Co., which is the present style of the firm. They confined their manufacture chiefly to superior classes of

bolts and did such an extensive business that in 1859, they purchased the tools of The Miller Manufacturing Co., of Millers Station, Conn. The firm built up a large business during the following twenty years, from which they gradually withdrew, during the eighties, but which they continued until 1890, when they entirely abandoned this branch of their business, owing perhaps, to the powerful western competition. They have since confined their business to jobbing in carriage hardware and trimmings.

THEODORE D. F. READ.

Mt. Carmel.

Theodore D. F. Read, a prominent hardware dealer, in New Haven, Conn., began dealing quite extensively in carriage bolts during the early forties. This line of trade was in its infancy at the time and Read undertook to develop it through a system of trading which he followed quite extensively. He was a typical Yankee trader, and, in modern parlance, would be classed as a "hustler" and a "plunger." He began trading iron for bolts, with the Southington factories, and exchanging bolts for carriages and other vehicles with the manufacturers. He continued this traffic until he became the largest purchaser of bolts and nuts in the Southington market, and he extended his business so much that he occasionally found it difficult to meet his obligations.

In 1848, after the failure of Rugg & Barnes, Read purchased a portion of their machinery from Joel Parker, which he installed in Mt. Carmel, on a water power privilege owned by his father. He also purchased a quantity of machinery of L. B. Frost & Son, and began making bolts and nuts for the general market on a pretty extensive scale for the early period.

The business proved a failure in about two years, at which

time (1850) the machinery was placed in charge of one of Mr. Read's foremen and removed to Gananoque, Canada, where the first bolt and nut venture in the queen's dominion was inaugurated.

CLARK, NORTON & CO.
Plantsville.

In 1850, Messrs. Levi P. Norton and Lemuel Clark, under the style of Clark, Norton & Co., established a bolt factory near Plants' Corners, building a small shop at a point known in the early days as "Shackle Hollow," on Eight Mile River, a tributary of the Quinnipiac. The site was since occupied by the extensive works of H. D. Smith & Co., manufacturers of carriage hardware.

In the following year, Mr. Norton sold his interest to Mr. Clark, who continued the business until 1854, when the entire concern was purchased by the Plant Co. Clark, Norton & Co. made bolts only, purchasing their nuts from other manufacturers. Their heading was done by hand and the threads were cut by machinery, run by water power. Their entire product was carriage bolts of assorted lengths, for which they secured only a very limited market.

SMITH, NEAL & CO.
Southington.

The firm of Smith, Neal & Co. was organized by Lester Smith, Roswell A. Neal and Samuel Pratt, of Southington, Conn., in 1851. They built a factory on "Monahan's Row," near the old Southington railroad station, and began manufacturing carriage bolts, using the Rugg & Barnes method. In 1857 the factory was transferred to the Plant Manufacturing Company, who continued running it until 1859, when the machinery was removed to their home works in Plantsville, Conn.

BRISTOL, NEAL & CO.
Southington.

In 1853, shortly after Bristol, Moss & Co. sold to the Plants, J. D. Bristol (son of Julius Bristol) formed a partnership with R. A. Neal, calling themselves Bristol, Neal & Co., successors to Bristol, Moss & Co., and doing business in their old factory until about 1856, when they transferred to Southington and united with Smith, Neal & Co., whose little wood factory building stood where the present Peck, Stow & Wilcox Co.'s building now stands.

CLARK BROTHERS BOLT CO.
Milldale.

Clark Brothers' Bolt Co., of Milldale, Conn., is next to the oldest and by far the largest and most important establishment of the kind in Southington township. It also occupies a prominent position among the foremost bolt and nut factories in the United States.

The foundation for this progressive industrial enterprise was laid in 1851, at which time Mr. William J. Clark secured water privileges and a small factory building on the Quinnipiac River and began making cold pressed nuts to supply the trade. His capital consisted of six hundred dollars and plenty of "spunk" and his equipment consisted of two power presses, and an undershot paddle wheel and such tools as were absolutely needed. A paying business was established and conducted until 1852, when a fire occurred which involved a loss of about half of Mr. Clark's worldly possessions by destroying the factory building, and damaging or ruining the contents, which were only partially insured, and on which the policies were promptly paid. The interruption was serious, but not

fatal to the business, for with an energy that characterized all of his undertakings Mr. Clark took immediate measures to reconstruct his factory, and the work was so rapidly performed that a new factory was erected, equipped and doing business on the old site at the expiration of sixty days after the conflagration. This was a two story building, 24 x 50 feet, with an L 20 x 30 feet for a forging shop. Beside manufacturing cold pressed nuts, Mr. Clark now added washers, kettle ears and other specialties to his output, and also did a considerable trade in bolts made by other factories with whom he exchanged products.

In 1854 Mr. Clark's brothers, Henry H. and Charles H. Clark, became partners in the firm under the title of Wm. J. Clark & Co. The new firm continued to exemplify the spirit of progress already introduced by the senior member, and machinery was constructed to make kettle ears of all sizes, both plain and tinned. They also added hand rail or stair rail-screws, probably the first made in the country, to their list of products.

Meanwhile the bolt machinery and business of Clark, Norton & Co., of Plantsville, Conn., was sold to The Plant Manufacturing Co., a competing concern, and the mutually valuable traffic alliance that had existed from 1851 between the two "Clark" companies was broken up, but a large share of the "good will" of their carriage bolt trade adhered to their selling agents, viz.: Wm. J. Clark & Co., and was soon provided for elsewhere, until such time as it was found expedient or practicable to make the bolts in their own factory. At this time they had not sufficient room or power, and they were also aiming first to introduce machinery for square head bolts, coach screws and plow bolts..

They also purchased a new patent for a detachable carriage shaft coupling, and fitted up ingenious machinery for milling the joints and tumblers accurately and expeditiously, so that when rightly attached to the vehicle they were readily coupled

or uncoupled by raising the outer point of the shaft to nearly a perpendicular position. Many other improvements and additions to the equipment were made at this time, which, however, in the course of two years reached the limit of power that the ancient undershot paddle wheel would yield and which made it necessary to lease room and steam power of a neighboring manufactory near "Hitchcock Station," in which to operate two or more additional nut presses of a capacity up to $5\frac{1}{8}$ -inch bolt size.

During 1855, the steam power company failed, which necessitated the removal of the nut machinery to a factory building supplied by water power, nearly a half mile distant, where room and power was leased for a term of years, and also a new heavy double back geared nut press installed for the manufacture of large sizes of nuts up to $1\frac{1}{8}$ -inch bolt size.

The divided factories (before the day of telephones) caused so much extra expense for intercommunication and shipping of products that the Messrs. Clark went into a thorough study and investigation of the hydraulic capacity of their water power and also of the various turbine wheels on the market adapted for such uses, and in 1857 had a new double turbine wheel constructed to suit the local conditions and installed with further additional buildings so that they obtained a double amount of water power thereby, and the machinery in the distant factory was moved into this addition and the business centralized in the home plant, and implements for making square head, machine and carriage bolts by hand heading process were installed. About this time a number of new designs were introduced for plow bolts for steel plows, for which the factory made a leading specialty, and secured an extensive sale in the western markets. Carriage bolt machinery was also installed, consisting of rounding presses, pointing machines, upright tapping spindles, threading and turning lathes, etc.

In 1858, an automatic tire bolt heading machine was purchased, which was of curious construction, but of considerable

eficiency. Its frame bed, resting on timbers, was constructed with crank and connection to a massive, round plunger slide. The adjustment of the plunger die was made with the usual taper wedge by driving it up or down. The closing mechanism was a huge cast shaft beveled geared to the driving or main shaft on the outside of and extending the full length of the frame or bed. This shaft operated the holding dies and the ratchet roll feed with cam motions. The holding dies were held in position by studs, nuts, and clamp buttons, and adjusted by blocking in the same manner as by the Chapin header of the present day, one die being held stationary while the other moved back and forth, held in a cross slide, working through the side of the bed and being operated with a cam. The machine had no stock gauge, hence the teeth on the ratchet feed had to be very fine and the use of not less than twelve pawls was deemed necessary to secure anything like accuracy in feeding. This arrangement was afterwards improved by using a friction feed disc, which proved very satisfactory. This was their introduction of cold forging tire, stove and kindred bolts and rivets from coiled wire automatically. At this time, more space being required, a one-story forging shop was erected on the opposite side of the roadway and power conveyed thereto by means of a belt passing over the street. Additional rounding presses were put in for forging the round portions of carriage bolts from square iron and increased facilities for hand-heading the same.

Early in 1859 their first Chapin heading machine was installed in this building, which proved so eminently efficient in the hands of skillful operators and concentrated thought. For it was on this machine that it developed, that the "square" could be produced from the "round" much cheaper, and better than the round from the square. The Clark brothers were men of progressive ideas and they were ever on the alert for improvements and novel devices. They employed the best mechanics that could be procured and encouraged those of an

ingenious turn, to develop their new ideas. It was due to this policy that no inconsiderable number of the most valuable inventions connected with the development of bolt and nut machinery, originated in their factory at Milldale.

Here Mr. E. W. Pierce, an ingenious mechanic, was employed to build a machine for heading off the rod. This was the second machine that ever successfully headed and cut the bolt off the rod at one operation, and it turned out plow bolts at the rate of 8,000 per day, which was considered marvelous at the time. Square heads were also produced on this machine, in the same manner, and were trimmed cold on power process. The machine was so complicated, however, that it was in a few years superseded by improved machines less liable to get out of repair.

In 1868 Wm. J. Clark & Co. accomplished the remarkable engineering feat of turning the water of the Quinnipiac River from its natural course above the present dam through a canal or new channel across the meadows and fields one-fourth of a mile to the river course again lower down the stream.

This feat completed and with new and very much more commodious buildings erected on the new raceway and new water wheels installed, the power and room was more than doubled thereby; and ample yard room remaining to make additions of buildings and steam power whenever the business might again demand or justify it.

A considerable portion of the old machinery was removed from the former cramped quarters and modernized, where needed, and properly located in the new factory, and new machinery was also added to increase the efficiency as to quality and quantity of the output.

This company contributed many original ideas and devices, notably among which were semi-hammer dies, which formed square heads by compression on two sides of the head simul-

taneously with the action of the plunger, thus forging the head by turning the bolt back and forth at each stroke of the machine.

Following these they introduced box dies for forming square heads, originally made with trimming grooves, which removed the burr during the operation. Later the trimming groove was dispensed with and the burr or fin was forged down. This operation required the use of two machines to complete the bolt, which was headed on one machine and finished on another, with a single heat. Undoubtedly the foremost invention originated by the company was William J. Clark's patented method of forming carriage bolts from round iron by machinery, an achievement that at the time completely revolutionized this branch of the trade, and one that still stands unrivaled in the history of the business. This invention and that of the concave neck carriage bolt is fully described elsewhere in this work.

Among the experts employed in the factory, most of whom became prominent in different sections of the country, were Micah Rugg, Martin Barnes, Daniel A. Waterous, Erastus W. Pierce, I. P. Lamson, L. S. White, E. L. Pierce, W. F. Swathell, William H. Hitchcock, William R. Wilbur and others. Beside attending to his regular mechanical duties, Martin Barnes had a specialty. He served as dentist for the employés and others and extracted teeth, using the old-fashioned "turnkey" as it was called, formed like a cant hook, a most terrific instrument of torture, but holding a record of never failing to extract the offending molar that it clutched. Mr. Barnes had a slight impediment of speech, that always became aggravated while he was engaged in one of these surgical operations. At these times he indulged in a series of osculatory sobbings, intended, perhaps, to quiet the nerves and bolster the courage of his patient. While adjusting his cant hook and wrapping it in a red bandana handkerchief, he would emit "s-ip, s-ip, hold-s-ip, still, s-s-ip, sizz-z-z," and by this time the work was all

done but the shouting, and the shouting was done by the patient. Mr. Barnes was employed in the factory till 1891, serving over thirty years.

There was another specialist in the shop, John Weber, by name, a little Frenchman, known as "Little John," whose specialties were manifold. Beside running a rounding press, at intervals, he ground razors, cut hair, shaved the men, fired the furnace, screened and assorted the cinders, and at other times, made himself generally useful.

The factory was situated about half a mile from Hitchcock Station and all materials used and shipped were hauled back and forth by ox teams, and "Old Pomp," a venerable steed who served for a score of years or more.

The water privileges, proper, were controlled by factories located on the ponds about a mile up stream, and Clarks used water at second hand, coming to them through the river after being liberated from the upper reservoirs. This often involved the delay of an hour or more in starting the machinery mornings during the dry seasons until the flow from the upper dams came lazily down and accumulated in sufficient quantity to put the wheels in motion. This was practically remedied by the introduction of an upright engine of twenty-horse power. At times, however, during the dry seasons of the year, the water supply became inadequate, and caused a temporary suspension of operations. At these times, the hands would find employment on neighboring farms, or, perhaps, enjoy themselves fishing, but later on abundant steam power being supplied, all these delays were disposed of and practically forgotten.

The product of the factory covered a broad range, including nearly every style of bolts, nuts and rivets in use, and also lag, coach, and skein screws, hence workmen who graduated in the establishment became proficient in the various branches and were rated as "past masters" in the art, and many of them became leaders in the business in the Middle and Western States. Messrs. I. P. Lamson and Martin Barnes, who were afterwards

associated in a contract to make bolts for the Clark Company, were former fellow workmen in this factory, Mr. Barnes having charge of finishing and Mr. Lamson turning bolt heads with a hand chisel, and operating ("running") a Chapin header and a cold nut press.

Mr. William J. Clark, the founder and senior partner of the company, remained with it and aided in the promotion of its steadily increasing prosperity, until 1871, when he sold his interest to his brothers, Henry H. and Charles H. Clark, and the firm of Clark Brothers & Company was established, and two active young men, Messrs. Wm. H. Cummings and Robert W. Bemiss, who had been in the office employ for many years and were thoroughly acquainted with the business, were admitted as partners. Mr. Bemiss's connection with the company was severed by his death, which occurred April 16, 1893, at the age of 52 years. Mr. Bemiss had been connected with the business from boyhood as an employé, and as a member of the firm, and he was recognized as a thorough business man whose services had largely contributed to its welfare.

In 1884 it became apparent to Clark Brothers & Company that another advance must be made in the line of bolt forging machinery and the matter was earnestly discussed by them with Mr. Wm. H. Hitchcock, their mechanical foreman, resulting in orders for experimental work to be undertaken at the first practicable opportunity in the direction of cold forging the head and square neck of a carriage bolt from round wire directly from the coil of Bessemer or open hearth steel that had now become tractable for many cold processes of treatment.

They expended much time and money in mechanical devices during the succeeding two years in testing methods, which finally resulted in practicable solid die cold forging of carriage bolts at one operation, and which later led to the open die method which permitted this use on longer lengths of bolts.

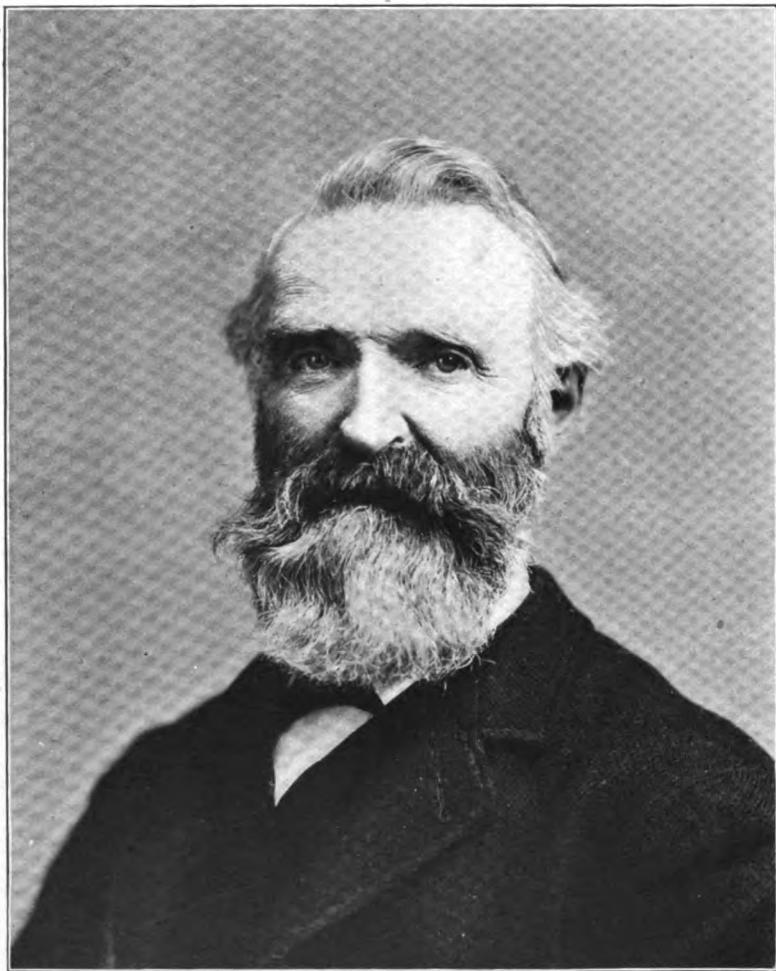
The prosperity and steady growth of the company continued until November 3, 1893, when a disastrous fire occurred,

which destroyed the entire works, including the office, warehouse and other buildings. An interested friend said during the conflagration that he hoped "the fire would prove a blessing in disguise," but unfortunately, on account of insurance and other losses, the fire proved serious, but no setback was allowed as the company had good orders booked ahead for winter business and a new main building was erected with new shafting running in sixty days after the fire. It required some little time for a complete re-equipment of the new plant. Machinery, tools, special dies, etc., were required, yet the orders were filled and customers taken care of.

The co-partnership of Clark Brothers & Co. continued until March, 1903, when the business was incorporated under the title of Clark Brothers' Bolt Co., Charles C. Persiani and Edwin S. Todd being admitted as stockholders. At the formation of the new company the following officers were elected: Henry H. Clark, president; Charles H. Clark, vice-president; William H. Cummings, treasurer; E. S. Todd, secretary; Charles C. Persiani, superintendent; Charles W. Clark, sales agent.

The bulk of the product of Clark Brothers' Bolt Co. goes directly to consumers, engaged in the manufacture of agricultural implements, and many original and special patterns of bolts have been introduced by them to this class of trade, meeting the requirements for constructing special farming tools, as improved from time to time. Their present lines include carriage, machine, plow and special bolts and rivets; hot forged and cold punched nuts and washers; coach, lag, and skein screws. In connection with their bolt factory they have a large cooperage plant which not only supplies their own needs for kegs and casks, but also those of neighboring factories. This company furnish goods in their various lines which compare favorably with the best products of the kind on the market.

A number of years ago a western agency was established in Chicago, under the able and enterprising management of Charles W. Clark, who is a son of Henry H. Clark, and who



William Judson Clark

has been connected with the bolt business since early boyhood. During the past fifteen years Mr. Clark has been employed as traveling salesman and as manager of the Chicago office.

WILLIAM J. CLARK.

Portrait taken at 60.

Hon. William Judson Clark was born in the town of Southington, Hartford County, Conn., August 19, 1825, of a parentage descended from three separate lines of Clarks, who were among the founders of the Connecticut and New Haven colonies, 1635-1639. He was reared as a farmer boy, attending the traditional "little red school house" winters, until fifteen years of age, when he entered the Southington Academy, situated three miles from his home, to and from which he walked daily. Much of his time was required on the farm, but by arduous study, evenings, he easily kept up with the studies of his classmates in preparing himself to attend college.

In the spring of 1845 a severe attack of ophthalmia compelled young Clark to relinquish his studies for a year, but in the fall of 1846, his sight was sufficiently restored to enable him to take charge of the high school at West Avon, Conn., where he met with very flattering success as an instructor. Not content with this occupation, however, he formed a co-partnership with his brother-in-law, Hezekiah C. Cummings, in the spring of 1847, under the style of Cummings & Clark, and opened a general supply store at Hitchcock's Basin, which was near his home and on the Farmington canal. The firm also leased a canal boat and established a freight line between the "Basin" and New Haven, bringing in most of the heavy freight for Waterbury and Southington by this route. A new railroad being constructed from New Haven, reached the "Basin" in the winter of 1847, and the name was changed to "Hitchcock Station." The company did a successful business

for three years, at which time it was abandoned because the lease of their store expired and a renewal could not be obtained. Mr. Clark's ambition to explore the new and wonderful gold fields of California, induced him in January, 1849, to become one of a party of fifty-six sturdy "Forty-niners," who purchased and provisioned the 200-ton schooner, G. H. Montague, to make the trip via Cape Horn, to the far distant "Golden Gate" of California. The good ship sailed from New Haven on January 23, and reached her destination June 26, 1849, making the twenty thousand mile voyage in five months. After reaching the new El Dorado, and prospecting in the gold fields, with promising results, for some weeks, Mr. Clark succumbed to an illness which compelled him to abandon "roughing it" in the mountains and return to San Francisco for better medical treatment, where, after partially regaining strength, he engaged in manufacturing and supplying ground coffee to the miners and merchants, establishing a very profitable business and virtually introducing a new line of trade in the market, as good coffee thus freshly prepared was hardly known in the new country at the time. Improved health during the winter encouraged Mr. Clark to continue his profitable enterprise, but, being cautioned by his physician that it would be hazardous for him to remain in that climate during the summer, he disposed of his interests and took steamer passage via Panama, and reached home in April, 1850.

Mr. Clark's introduction to the bolt and nut business occurred soon after, when he contracted with Clark, Norton & Co., a local firm of carriage bolt makers, as traveling salesman to make a trip "Out West," which meant as far as Buffalo, at the time, and sell their product. His success as a salesman in this undertaking induced him to embark in the nut and washer manufacturing business on his own account, and thereby forming a business to his own advantage, and also to that of his employers, as they having no nut making machinery were buy-

ing their supply in the open market, and to this end he secured a dilapidated factory building and water power, known as Morse's Mill, and also as a "hoodoo," by the name of the "Old Carding Machine Shop," where in his youthful days one of his ten year old schoolmates of an inquisitive mentality had lost a hand by experimenting with feeding the open maw of the machine when it was "doing business." This mill he rebuilt and equipped with a small quantity of machinery and began making cold pressed nuts for the neighboring bolt makers, early in 1851. Success attained his efforts during the first year, and he added two power presses to his plant. But the "hoodoo" seemed to take effect in the following year, for in May, 1852, the entire factory was destroyed by fire.

The blow was severe but by no means fatal. The loss was substantially total, and the insurance, being for not more than half of it, the companies were prompt in making an equitable settlement. Mr. Clark's credit already established enabled him to mature plans and contracts for rebuilding immediately, and at the expiration of sixty days a new building had been erected and machinery and tools had been renewed, and the wheels began turning as merrily as though no interruption had occurred.

In 1854, Mr. Clark's brothers, Henry H. and Charles H. Clark, were admitted as partners in the firm, and the style was changed to William J. Clark & Co. At this time various improvements were made, machine bolts, coach screws and plow bolts of special patterns were produced, some of the latter, with round countersunk heads, plain and with key and with square shoulder, being new to the trade. These were made by the customary hand-heading process of those times, and to furnish an air blast steadily for the four-sided forge, a homemade "blower" was constructed with board sides or housing, with the circular portions covered with zinc. The four paddles were made of wood fastened to iron arms bolted to a square shaft, the journals being babbitted in wooden bearings. The whole was a simple affair and is merely mentioned to illustrate

the inability of procuring ready-made machinery in those days. It supplied the purpose for which it was designed and demonstrated the fertility of the directing mind.

The threading lathes used were, at first, of the John Curtiss' two spring jaw variety, with one exception, which was a solid head adjustable die machine, which moved forward and back by means of a tail screw. In cutting the thread on the bolt it was also provided with back and quick reverse gears, which most appropriately gave it the title of "Racket," as it furnished noise for the whole neighborhood. But, however, it performed very excellent work. An auxiliary steam engine was installed for increasing the power.

The advent of the Civil War created a demand by the government for many articles that could not be supplied by the armories, among which were gun screws, which were needed in great quantities. With his ready adaptability and skilled assistants, Mr. Clark, Sr., as general superintendent, soon mastered the delicate mechanical work, and soon had the factory equipped to furnish screws after government patterns, which passed inspection at the Springfield armory, with a loss in inspecting of not over one per cent., while other factories met a loss of from four to ten per cent.

Although Mr. Clark had no practical training, his contact with machinery seemed to inspire his natural genius with new ideas, which he so successfully developed that he stands credited with having invented a number of ingenious devices that were of incalculable value in the progressive development of both bolt and nut machinery, notably among which was his method, introduced in 1863, of forging carriage bolts from round iron, which completely revolutionized the process of making this class of goods. This and other of Mr. Clark's inventions are fully described in the mechanical section of this work.

In 1871 Mr. William J. Clark retired from the active management of the company, though he retained an interest with his brothers until 1881. By this time Hitchcock's Station had

grown to be a thriving village, and yet the nearest post office was over a mile distant, entailing great inconvenience to the growing industries in the vicinity. To remedy the difficulty, Mr. Clark visited the post office department at Washington and presented such a practical view of the matter that an office was soon located at the village and the name was changed to Mill-dale, which is still retained.

In public life Mr. Clark was active and useful in many ways. In politics he was a staunch Republican, and served as chairman of the town committee of Southington for twelve years and until he declined a re-election. As a Union man during the Civil War, he was an active force, aiding his State and the general government in many ways in meeting the unfortunate conditions of the period. He was a trusted friend and confidant of War Governor Buckingham, having been a delegate to the State convention that nominated him in 1858, and his staunch supporter at the succeeding elections that kept him in office for eight consecutive terms, covering the entire period of the war.

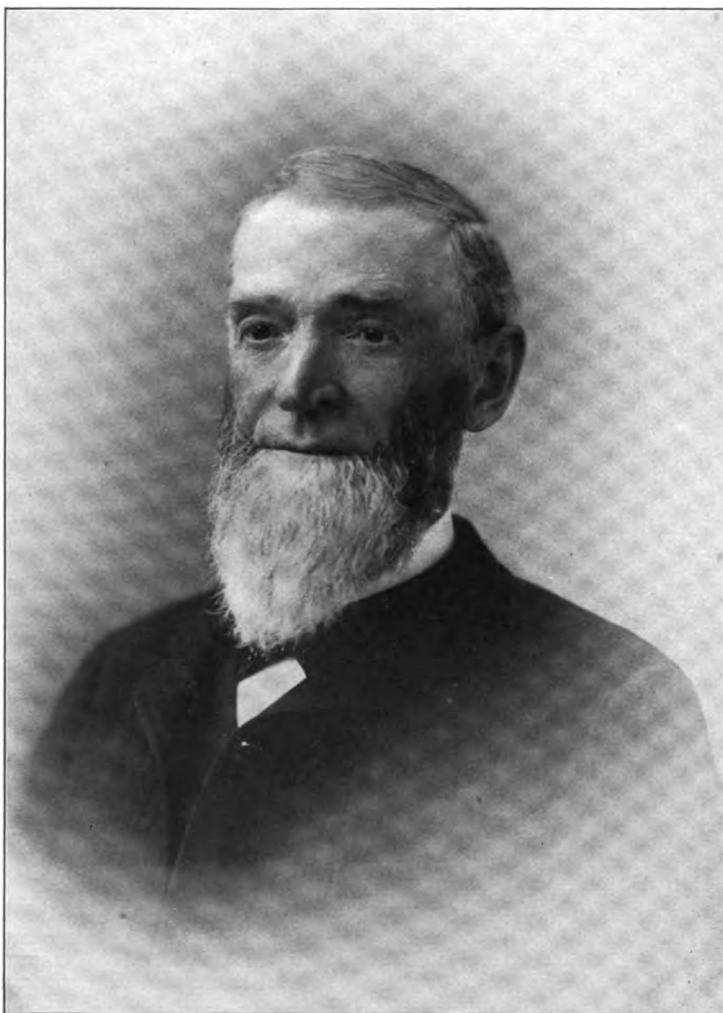
Mr. Clark was an organizer of the Union League in his township in 1862, to support the government, and was its president to the end of the Civil War. He was also among the first to inaugurate the movement at Washington which resulted in the "Furlough Act," in 1863, which granted invalid soldiers a thirty-day furlough to visit their homes.

One of the thrilling experiences of Mr. Clark's busy life was a trip to the gold and silver fields of Montana, made in 1865. After two years of toilsome but unprofitable prospecting in various sections of the mining territory, during which hardships were encountered that resulted in serious and protracted illness, Mr. Clark returned to Southington and again took an active part in the affairs of the company. Mr. Clark returned from Montana in the spring of 1867, with health impaired by excessive labor, cares and exposure in trying to extricate his mining company from impending failure; and the re-

mainder of that year was largely consumed as a recuperative vacation, so that he was substantially restored to normal conditions to engage in a then considered large engineering feat in 1868, of turning the waters of the Quinnipiac River from above the present dam through the cross country land one-fourth of a mile to the river bed again, lower down the stream. Many infringements had been made on his patents for forging bolts from round iron, all of which he brought to an accounting by his wisely adopted measures.

In 1881 the Southington Lumber & Feed Co. was organized by Mr. Clark and six other business men of the town. He was chosen a director in this company continuously to 1893, when he was elected its president. In 1882 Mr. Clark was elected to the State senate, defeating a popular Democrat candidate, and in 1883, he waged war against the aims of the *Ætna* Life Insurance Co., which sought to capitalize a large sum of money to which it claimed legal ownership, but which others claimed to have been wrongfully drawn from the "Mutual Department" of the company. A bill supporting the claims of the company was passed by the legislature, notwithstanding a demand for an investigation. Mr. Clark took the matter in hand, in behalf of justice, and personally employed and paid an expert to make a thorough investigation of the unaccountable wealth of the "Stock Department," and, securing proof of illegal methods on the part of the company, he battled for the right until 1887, when he secured the passage of a "substitute measure," empowering the insurance commissioner to investigate the affairs of any insurance company and protect the interests of the policy holders. "Truly," said Mr. Clark, when the battle was won, "though the mills of the gods grind slowly, they grind exceedingly small." In 1896 the courts justified Mr. Clark's course by ordering a restoration of diverted funds and enjoining the irregular transactions complained of.

Since retiring from active business, Mr. Clark has spent most of his time at his beautiful country seat, at Stony Creek,



Henry H. Clark

overlooking Long Island Sound and the picturesque Thimble islands. He is a trustee of the Stony Creek Congregational church, which he and his family attend, and generally interests himself in public affairs connected with the welfare of the pretty little hamlet. Though advanced in years, Mr. Clark enjoys excellent health, and though not engaged in active business he finds abundance of wholesome and agreeable employment for his vigorous, mental and physical faculties in caring for others who need aid and sympathy, and in sharing in the good work of elevating and bettering the condition of his fellow man.

Mr. Clark's long business life was of strenuous activity and noteworthy achievement, and he stands pre-eminent among the foremost men of genius who have contributed to the progressive development of the important bolt and nut industry of America.

HENRY HERMAN CLARK.

Henry Herman Clark, one of the oldest living bolt makers now continuing in the business, was born in the town of Southington, Conn., May 14, 1829, and has resided in his native town the greater part of his life. Mr. Clark is indebted to the public schools of Southington and Lewis Academy of Southington, for his ample educational advantages.

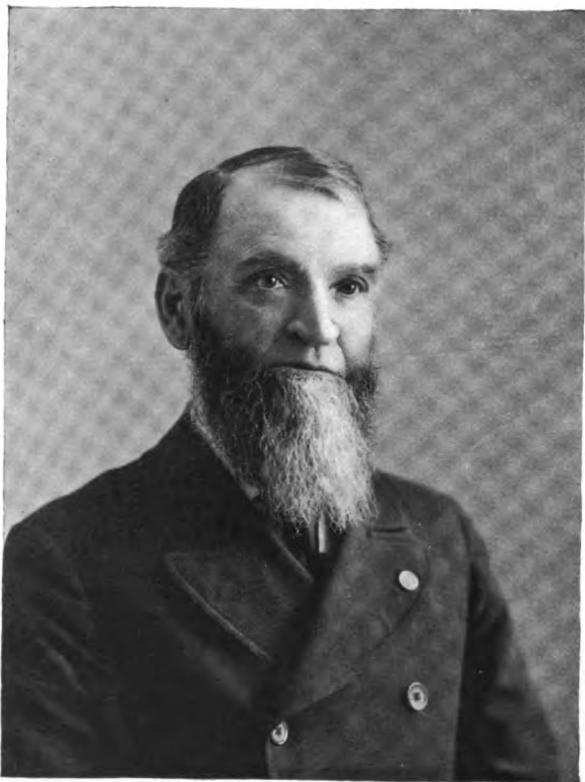
In 1845 he engaged in the mercantile business at Milldale, with his brother-in-law, Hezekiah C. Cummings, and three years later removed to Watertown, Conn., where Mr. Cummings entered into new arrangements for a well established mercantile business with which he had been formerly connected. At the death of Mr. Cummings in 1850, Mr. Clark succeeded him in the business there until 1854, at which time he sold out, returning to his native place, and in company with his two brothers formed the partnership of Wm. J. Clark & Co. (succeeding Wm. J. Clark), manufacturers of bolts and nuts. In 1871, upon the retirement of Wm. J. Clark from the business,

Mr. Henry H. Clark became the senior member of the succeeding firm of Clark Bros. Co. (successors to Wm. J. Clark & Co.) and has ever since been at the head of the concern, and is now president of the Clark Bros. Bolt Co., incorporated.

On September 29, 1852, Mr. Clark was first married to Miss Mary C. Davis, of Watertown, Conn., who died in August, 1866. In a second marriage on January 29, 1874, he was united to Miss Susie Curtiss of New York city, his present wife. His two daughters and son now living are: Carrie Luella, wife of Warren Williams, of New Haven, Conn. (formerly wife of the late Edson L. Frost, of Marion, Conn.), Miss Flora L. of Milldale, Conn., and Charles W. Clark, of New Haven, Conn., who at present is manager of a western office at Chicago, devoted to the bolt business.

Mr. Clark, while he has refrained from accepting any political honors, has always been an ardent Republican. He has been associated with many business enterprises in his town, and at the present time is president of the *Ætna Nut Co.*, of Southington, Conn., which position he has held for many years. His connection with the success and growth of the Clark bolt business has been important and creditable. For a great many years he has been an exceptionally patient and devoted worker and the prestige and enviable reputation of the bolt company of which he is president is due largely to his careful and able management. He is conservative and yet progressive and enterprising, and always ready to adopt such improvements in business as will keep a concern abreast of the times. It was through his suggestion and persistent effort that the cold heading of plow, machine and carriage bolts was worked out successfully in Milldale.

His record in public and personal affairs is that of an honorable and conscientious man, whose upright life and charitable spirit, always ready to help those in need, have won for him the esteem of all with whom he has come in contact, and have justly numbered him among the leading and most useful citizens of the town.



Charles H. Clark

CHARLES HULL CLARK.

Charles Hull Clark, youngest son of Deacon Theodosius Clark, was born in Milldale district, Southington township, October 23, 1832. After completing his education and graduating from the Lewis Academy of Southington, he assisted his father on the farm. Mr. Clark early evinced a natural aptitude for managing men and machinery. In 1854 he engaged in the manufacture of bolts and nuts. At this time he became a partner with two elder brothers, William J. and Henry H. Clark, under the firm name of William J. Clark & Co., located at Milldale district, Southington, when he was made general superintendent of the works, a position that he held until 1862, when he enlisted in the 20th regiment, Connecticut Volunteers, and departed for the front. During his second year of service in the army, Mr. Clark was made a lieutenant on the staff of Col. James Wood, commander of the third brigade, third division of the 20th army corps, stationed in front of Atlanta, Ga. In the fall of 1864 Mr. Clark retired from the service and resumed the position of superintendent of the factory at Southington.

In 1871 William J. Clark retired from the firm and the title became Clark Bros. & Co. Mr. Clark continued to superintend the works until 1882, and he became vice president upon the incorporation of Clark Bros. Bolt Co., a position which he still holds. Mr. Clark maintains a live interest in the business, which he has so materially and successfully assisted in building up. Mr. Clark is also a director of the Southington National bank, and the Southington Savings bank, besides being interested in several other local manufacturing enterprises.

In politics Mr. Clark has always been loyal to the Republican party. He was elected to the Connecticut legislature in 1895 and again, with an increased majority, in 1899, receiving

the support of many opposed to him in politics. Mr. Clark has served in a number of local offices, always with notable ability and fidelity.

Mr. Clark is an honored and widely useful member of the Grand Army of the Republic and has always taken a prominent part in the local, State and national affairs of the organization.

Mr. Clark has always been active in the promotion of public improvements and utilities and especially in the development of trolley lines and the improved methods of transportation and communication that have contributed to the growth and commercial importance of his native town and State.

In public and private life Mr. Clark has fulfilled every obligation with the same earnestness and fidelity that has characterized the conduct of his extensive and successful business undertakings.

Mr. Clark was married to Miss Mary E. Dickerman of his native town on August 21, 1862.

THE FRANKLIN MOORE COMPANY.

Winsted.

It has been impossible to secure sufficient data to furnish a complete early history of the bolt and nut business in this thriving little city. The founders of the industry have passed away; books and records have nearly all disappeared; but from what remains we have gleaned the following trustworthy facts:

The original founder of the industry in Winsted was Doctor Case, a clever gentleman in his many commercial dealings. It is known that he commenced the manufacture of small cold punched nuts as early as 1848, in connection with his grist mill business, styled the Clifton Mill Co. Soon after Doctor Case induced his company to erect a small two story shop near the mill and to devote it to the manufacture of bolts, including the larger sizes of cold punched nuts. During the early fifties Doctor Case became associated in the business with William G. Coe.

The heading was first done by hand, but later on, Adolph Frienck, of Newark, N. J., who engaged Taylor & Whiting, who were running a machine shop, to build for him a machine, of his own invention, designed for forging heads on carriage bolts. It should be parenthetically added here that this machine subsequently became widely known as the "Chapin Heading Machine," and that this original machine afterwards became the property of J. B. Savage, of Southington. A machine built by Taylor & Whiting, on the lines of Mr. Frienck's machine, was employed and the water power was supplied by the milling company. The introduction of this ingenious device was quite an event in the little town, and it awakened a decided interest among the enterprising men of the village.

Mr. Coe was imbued with political ambitions and was elected a member of the lower house of the State legislature in 1859. Some years later Mr. Coe became a railroad promoter, In the meantime, Doctor Case died and Mr. Coe had become so absorbed in his railroad interests that the bolt and nut business of the Clifton Mill Co. was allowed to dry up and fall into ruin and decay and there the curtain falls.

There are those still living in Winsted, who can remember that the new enterprise was regarded as something very wonderful at the time, and that an eccentric genius, known as "Old Hy Gouger," was employed to operate the heading machine; that Hy was formerly a rolling mill heater, and therefore considered a gifted mechanic, and that he was assisted by two or more men of the same stripe; but no one seems to know, exactly, whether or not the enterprise was successful. The records show, however, that one or two other machines were built and operated. It is known also that as late as 1871, these old heading machines were standing on the site of the former factory, coated with rust, silent and abandoned and exposed to the weather, as all traces of the buildings that had formerly surrounded them had almost entirely disappeared.

It was in this little and almost forgotten factory, however, Mr. Franklin Moore learned the trade of bolt and nut making and had charge of the machinery, and it was after him that the present Franklin Moore Co. of Winsted was named.

In 1869, Messrs. Edward Clark and Franklin Moore opened a carriage bolt factory in Winsted, using the heading vise and hand tool. In 1875 they enlarged their plant and introduced drops for heading. Messrs. Moore & Clark did a prosperous business for a number of years, when Franklin Moore purchased the entire business. Later on a new organization was effected under the title of Franklin Moore & Company, which was again succeeded by the Franklin Moore Company, which was incorporated.

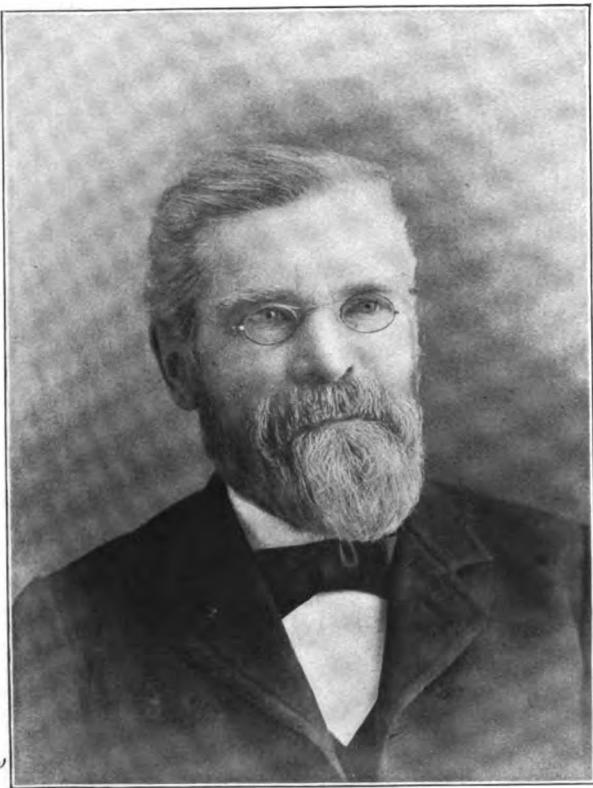
This company built large factory buildings near Main Street on the outskirts of the city, which they equipped with modern machinery. To this factory the entire machinery and business was removed. This company manufactures a superior class of goods, known as "The Charter Oak" Norway iron carriage, tire and fancy bolts.

The officers are: John B. Adams, president; William H. Taylor, vice-president; Julius H. Whiting, secretary and treasurer.

During the eighties a company was organized under the title of the Winsted Norway Bolt Co. This company was absorbed by The Franklin Moore Co., its machinery and effects being removed to their factory.

MR. GEORGE DUNHAM.

Mr. George Dunham, the veteran inventor and manufacturer, was born on Queen Street, Southington, Conn., April 7, 1830. He worked on his father's farm, attending the village district school during the winter seasons, until he was twenty-one years of age, when he secured employment in the factory of H. A. Miller, located nearby. Here he took his first lessons



Geo. Dunham

in the art of heading carriage bolts by hand, and for two years applied himself so faithfully that he not only mastered this branch of the trade, but familiarized himself with other branches. In the following year he was employed making tinner's machines at the works of Royce & Wilcox Co., East Berlin, Conn., where he gained further proficiency, and earned a salary of twenty dollars per month, paying his own living expenses.

On January 1, 1853, Mr. Dunham entered the service of Peck, Smith & Co., of Southington, receiving a salary of one dollar per day. A year later he became connected with the Miller Bolt Manufacturing Co., a joint stock concern, that succeeded H. A. Miller, in which Mr. Dunham purchased a small amount of stock. In this factory he was employed in making taps and dies and as superintendent of machinery. The factory was run at intervals, as orders were received, and Mr. Dunham alternated between working on the homestead farm and at the factory, never failing to be promptly on hand when his services were needed at the latter. This period of shifting employment continued until the company failed, and its effects were purchased by The Plant Co., and removed to Plantsville. During these years of uncertainty, however, young Dunham's mind was always busy and his natural genius was being developed. He constantly studied the various styles of machinery in use, with a view to inventing new and better methods, and his future success as an inventor testifies that his labors were not employed in vain.

Soon after the failure of The Miller Bolt Co., Messrs. Thomas H. Lamson and S. W. Sessions operated the abandoned machinery, under a contract to furnish bolts for the Plant Manufacturing Co., and Mr. Dunham was employed in the factory. The panic of 1857 terminated this arrangement, and Mr. Dunham again returned to the farm where he continued until the close of 1858.

In February, 1859, Mr. Dunham secured the position of superintendent of the bolt factory of Dwight Langdon, of Unionville, and during the year that he remained in this employ, he was enabled to develop many of the ingenious ideas that won for him a world-wide reputation as an inventor of nut machinery.

In 1860, Mr. Dunham and Andrew S. Upson formed a co-partnership and purchased the Langdon plant, which they managed successfully for five years, at the expiration of which, in 1865, Mr. Dunham sold his interest to Mr. Upson, and devoted his entire attention to the invention and improving of nut machinery. During this year he secured his first patent on an improved hot-forged nut machine, built on entirely new and original lines, which was free from many objectionable and troublesome features met with in all previous inventions. In 1868 he obtained an additional patent on improvements which perfected his machine, presenting it as it stands to-day, with the exception of a few minor details that do not affect the principle of its original construction. This superior machine has never met a rival for its proficiency in finishing and rapidity of production, and it is known and valued throughout the world as the "Dunham forge nut machine."

In 1887, Mr. Dunham brought out his multiple forge nut machine for making four nuts at one operation, which he afterwards converted into a clip yoke machine.

Following this came his automatic cold nut press, which punched, cut, crowned and trimmed the nuts, entirely automatically from the bar or coil at one operation. This machine has also gained a wide sale in the markets of the world.

Besides these, Mr. Dunham has secured patents on numerous other improvements and devices, notably automatic machinery for making hexagon nuts, also complete sets of automatic machinery for making finished and semi-finished hexagon and square nuts in their various styles.

Mr. Dunham, in company with his sons, is successfully engaged in the manufacture of his various machines at Unionville, Conn., where he still resides. Mr. Dunham stands at the very head of his class as an inventor of nut machinery. Throughout his many years of activity he has been a very busy and productive inventor and the results of his ingenuity and perseverance are clearly stamped on nearly every stage of progress in the development of the great bolt and nut industry of America. Though well advanced in years, Mr. Dunham is still active in his business and is interested in all matters that relate to advancement in morals and religion in the community.

NOTE.—Since the above was written, in 1904, Mr. Dunham has sold his entire business to the Garland Nut & Rivet Co., and has retired from active business.

PHILIP KOCH.
New Haven.

Mr. Philip Koch was a man of genius, whose business career was one of varied successes and disappointments, and who in the end became a martyr to anxiety and the overtaxing of his faculties.

While employed as foreman in the spring works of Gilbert J. Hines, on Howard Street, New Haven, Conn., Mr. Koch invented and assembled his first forge nut machine, in the development of which he was financially assisted by Mr. Hines, through whom the Unionville, Conn., people also became interested in the forge nut business. A patent was secured on the machine, dated May 5, 1863.

“No. 38,397. Philip Koch of New Haven, Conn. Improvement in machine for making nuts. Patent issued May 5, 1863. Antedated April 18, 1863. The bar is pushed through a hole in the cutter, and the ascending lever cuts off a blank, which is then passed to the die, which removes the

central portion, and after being hammered and dressed, it is discharged from the machine. The motions are too intricate to be explained within moderate limits."

Mr. Koch's machine made a handsomely finished forge nut, by cutting off the blank, when it was crowned and punched, and thence transferred to where it was forced onto a pin and hammered, after which the pin was withdrawn and the nut was passed under a top hammer or flattener. The process was not rapid, and the machine was so complicated that it was liable to get out of order. Yet the superior character of the work it performed was a redeeming feature that enabled Mr. Koch to turn it to considerable profit. He sold the State rights of Pennsylvania to the Colemans of Philadelphia for \$50,000 and also sold the rights of Michigan and Indiana to the Michigan & Indiana Bolt & Nut Works, of Detroit, for a good price.

The influx of financial aid induced Mr. Koch to bring out his multiple machine, designed to make six nuts at one operation. This ingenious invention he undertook to place in England, but meeting with little encouragement, he abandoned the effort and went to Germany, where he induced a few young and enterprising men to embark in the bolt and nut business on the American plan. After establishing a plant which did a fairly prosperous business Mr. Koch retired from the business and, in company with his son, started a nut finishing factory, which was conducted with but moderate success until the death of his son occurred. This calamity, following a series of other discouragements, so completely overwhelmed Mr. Koch that he lost his mind and subsequently died in an insane asylum.

It is said that the nut finishing business inaugurated by Mr. Koch and his son is one of the largest works of the kind in Germany.

REYNOLDS & CO.**New Haven.**

Reynolds & Co., of New Haven, Conn., became engaged in the business in 1865. Their product was square head and hexagon machine and coupling bolts, forged entirely by hand. They discontinued this line of business in 1885, adopting in its stead the manufacture of set, cap and machine screws, for which they have established an extensive trade.

PECK, STOW & WILCOX COMPANY.**Southington.**

This prosperous company is not the offspring of the "let well enough alone" policy. On the contrary, its splendid development has been the result of the principle of expansion, wisely and judiciously employed. The original firm was The Peck & Smith Co., located on Railroad Street and the Canal railroad, Southington, Conn. Subsequently it united with The Stow Manufacturing Co. of Plantsville, Conn., and The Hart Manufacturing Co. of Kensington, Conn., thereby laying the foundation for a chain of factories that are known as The Peck, Stow & Wilcox system. In 1880 they established a large factory in Cleveland, O., which forms another branch of their system and whose principal product is shelf hardware, tinners' machines, etc.

Peck, Stow & Wilcox embarked in the bolt and nut business in 1866, at which time they purchased the machinery and fixtures of a factory owned by Thomas H. Lamson and Walter W. Woodruff, at Mt. Carmel, Conn., which they removed to their establishment in Southington and began the manufacture of pinched-neck, common, carriage bolts and nuts. While the bolt and nut business was being installed, Mr. Wilson Davis, the engineer of the factory, rendered val-

uable assistance. He was an able mechanic and an inventive genius, and, beside attending to his regular duties, he found time to operate a forge nut machine and to invent a number of useful devices. In the latter line, he resurrected from the scrap pile an abandoned Chapin Heading Machine, which he so reconstructed that it served to cut all of the iron for the factory. This was accomplished by placing the rods, vertically, in a rack so that they were fed down to the gauge by their own weight. By this process as high as eight blanks were cut by a single stroke, and one man was kept busy, replacing rods as fast as the rack was cleared. The fact that the surplus at the upper end of the rods, after the requisite number of bolts were cut, dropped among the blanks and had to be removed, proved a defect, but, in all other respects, the device was a pronounced success. The bolt and nut business, however, was only a secondary consideration with Peck, Stow & Wilcox. This branch of their business was never provided with a strictly up-to-date equipment until during the nineties, when the firm purchased J. B. Savage's old building, which they practically rebuilt and equipped with their bolt and nut machinery and occupied in January, 1894. Even in this new plant, however, they used a number of primitive devices, notably the old overhead spring poles for raising the clappers, and also belted directly from the line shaft, using tight and loose pulleys on the shaft. These devices were used on the machines operated as early as 1857, and this is probably the only factory that still continues their use. For a number of years the bolt and nut branch was known as "Wilcox's Bolt Shop," a circumstance due, perhaps, to the fact that Mr. William Wilcox was a heavy investor in the Peck & Smith Company. In consequence of a series of accidents caused by the fact that their old building stood at an elbow of the street so that approaching trains were entirely hidden until they reached the railroad crossing, this structure was torn down and the machinery was removed into the J. B.

Savage building. This gave a clear view of the railroad trains approaching in either direction and put an end to the frequency of accidents.

Peck, Stow & Wilcox Co. manufacture but two classes of bolts, viz.: Common and Eagle carriage, and make no sizes larger than one-half inch.

The present officers of the company are: A. R. Treadway, president; F. L. Wilcox, vice-president; S. Walkley, treasurer; E. N. Walkley, secretary; Marcellus (Poky) Wilcox, manager.

THE AETNA NUT COMPANY.

Southington.

In 1869, R. A. Neal, familiarly known as "Boss" Neal, organized The *Ætna* Nut Co. He was financially assisted by Peck, Stow & Wilcox and established his factory on the east side of the railroad in what was known as "Monahan's row," Southington, Conn. He employed Mr. Abner Candy as superintendent and Mr. Lyman S. Taylor as manager. These two able mechanics had invented an axle nut, the value of which secured for them a certain interest in the business. Subsequently a rolling mill was added to the factory, which furnished the material used for small and medium-sized Dunham machine forged nuts, which were the largest made by the factory. While the company has not materially expanded, it has always done a successful business, making a specialty of supplying a trade largely through Peck, Stow & Wilcox, by which company their affairs were formerly practically controlled and of whose system of manufactories they were a part and parcel. Under the present management the officers are: Board of Directors: A. S. Upson, H. H. Clark, S. D. Neal, M. H. Halcomb, M. N. Woodruff, M. B. Wilcox, H. C. Judd; H. H. Clark, president; B. S. Porter, secretary and treasurer; S. D. Neal, general manager.

WALTER W. WOODRUFF.**Mt. Carmel.**

Soon after Messrs. Lamson and Sessions removed their business to Cleveland, in 1869, Mr. Walter W. Woodruff again occupied the premises vacated by them in Mt. Carmel. After replacing the old breast water wheel with a new Leffel turbine wheel and equipping his factory throughout with the latest-improved machinery he contracted with Wilbur F. Swathel and Lewis Avery to manufacture common carriage bolts, fixing the price per thousand on the several sizes and lengths, he furnishing all the raw material used, including nuts untapped and tire bolts unthreaded, and Messrs. Swathel and Avery contracted to do the entire manufacturing and also to keep the machinery in order and make their own tools. The prices agreed upon were \$2.40 per thousand for all lengths and sizes of carriage bolts up to $\frac{3}{8}$ inch in diameter, and \$3.00 per thousand for 7-16 and $\frac{1}{2}$ inch bolts. The price on tire bolts of all lengths and sizes was 75 cents per thousand. It was also stipulated that Mr. Woodruff should receive all goods at the packing benches and bear the expense of nutting, piling, papering, labeling, etc.

This arrangement continued one year, at the expiration of which Mr. Woodruff offered to turn over the entire business to Messrs. Swathel & Avery and to pay the expense of keeping the books and accounts, provided that they would pay him six per cent. annually on the amount of capital invested. This proposal being rejected, Mr. Woodruff at once sold the stock on hand to Messrs. Dodge, Gilbert & Co., hardware merchants, of Boston, and the machinery and fixtures to Messrs. Peck, Stow & Wilcox, who removed them to their works in Southington. This was the fourth bolt and nut company that had been established in the old abandoned axle factory building and it was the second company of the kind that had disposed of its machinery to Peck, Stow & Wilcox of Southington. It is

something to the credit of the ancient structure that it seemed not much worse after its long service and at the present day it is still standing in tolerable repair and still has another bolt company to put life under its roof.

After disposing of his business, Mr. Walter W. Woodruff became interested in the James Ives carriage trimming establishment at Ives' Station, Conn.

NEWHALL & CO.
New Haven.

Newhall & Co., extensive carriage manufacturers of New Haven, added a bolt manufacturing department to their establishment in 1869. Failing to meet their expectations, the work was discontinued in a few years.

KENNEDY BROTHERS.
Plainville.

The history of this company, like that of many others, can be briefly narrated. In 1871, James, Patrick and John Kennedy of Southington, Conn., and H. D. Miller of Plainville, equipped a factory, with two Chapin heading machines and etceteras, in Plainville, Conn., and began manufacturing pinched-neck carriage bolts. The plant was located at Hill's dam on a tributary of the Farmington River and on the site of the Hills & Carter planing mill. The firm fought a losing battle for four years, at the end of which its effects were sold to the Upson Nut Co., of Unionville, Conn., where the machinery was removed. Mr. Miller, son of H. A. Miller, furnished the capital and managed the business.

THE BEECHER MANUFACTURING CO.**Meriden.**

The Beecher Manufacturing Co. of Meriden, Conn., was organized in 1872, with the following officers: Henry M. Beecher, president; Daniel F. Southwick, secretary and treasurer. Subsequently Henry D. Bassett became president and still later the officers were Daniel F. Southwick, president; S. W. Kent, secretary and treasurer. The principal product of the factory was shelf hardware, but it also made square head, shackle, whiffletree, step and bullet head bolts by hand and with Olivers. The company continued in business until 1889, when its affairs were settled by S. W. Kent, who acted as trustee.

“Alas! the perils that environ

The man who meddles with cold iron.”

W. C. LANMAN.**Norwich.**

In 1879 Mr. W. C. Lanman erected a factory building on the site of the old shipyard in the section of Norwich known as “Thamesville,” which he equipped with steam power and machinery for manufacturing full square Philadelphia carriage bolts. The heading was chiefly done with drop hammers, and the bolts were made from bright wire by the Philadelphia upsetting or “staving” process, with a daily capacity of from 25,000 to 30,000 bolts. Mr. Bernard Gallon was superintendent of the works, which continued the business until 1887; at which time a suspension occurred and the greater portion of the machinery was sold to D. N. Bassett, of Birmingham, Conn.

“One more unfortunate, weary of breath, sadly unfortunate, gone” to swell the list of wrecks that strew the pathway of the bolt and nut industry of America.

BRADNACK & LEONARD.
New Haven.

In 1879 James Bradnack and Albert Leonard formed a co-partnership under the style of Bradnack & Leonard, and began manufacturing bolts, occupying one-half of a building on Chestnut Street, New Haven, with William Babcock, who furnished the power. After continuing business about two years the machinery and tools were sold to C. Cowles & Co., with whom Mr. Bradnack became associated. During his connection with Cowles & Co., Mr. Bradnack became interested in politics and served as alderman of New Haven with credit and ability.

MT. CARMEL BOLT COMPANY.
Mt. Carmel.

The Mount Carmel Bolt Co. was organized in 1880. The company is largely engaged in the manufacture of stove and tire bolts, but has never made carriage or other bolts. The office and works are located at Mount Carmel. The officers are Willis E. Miller, president; Samuel J. Hayes, treasurer; and Lyman H. Bassett, secretary.

JAMES B. CLARK & CO.
Plantsville.

An ingenious device for forging full squares on carriage bolts from round iron by a single operation, was invented by James B. and Lucas C. Clark of Plantsville, Conn., in 1880. In front of the round, grooved holding dies were arranged thin dies, corresponding in thickness to the length of the square to be forged on the bolt, which were thrown forward, to support the stock, while being driven down or compressed, to fashion the head and square. Excellent work was produced by the process, but the stress to which the square forming tools or

dies were subjected rendered the wear and tear in this direction so expensive that the machines never came into general use, though two or more went to Pillow, Hersey & Co., Montreal, Canada, and to L. D. Frost & Co., Marion, Conn. Nevertheless Messrs. Clark succeeded in forming a company under the title of James B. Clark & Co., consisting of J. B., L. C. and Solomon Clark, who occupied a small factory on the old Plant Manufacturing Company's site, where they manufactured and used the machines for a number of years, doing a fairly prosperous business.

THE CORBIN SCREW CORPORATION.

New Britain.

Though not recognized as an important center of the bolt and nut industry, the thriving city of New Britain, Conn., has materially shared in promoting this useful line of manufacture.

During the early fifties, Hiram M. and Chauncy Clark, invented bed screw forging machinery. This invention induced the organization of The American Bed Screw Company, which did a flourishing business for many years. They were followed by P. & F. Corbin, who began the manufacture of wood screws and other articles. This firm did a large business, and became a power in the industrial world.

Then came the Russell & Erwin Mfg. Co., which made a specialty of wood screws. During 1903, this company consolidated with P. & F. Corbin, under the title of The Corbin Screw Corporation. Their principal product is wood screws, but they also manufacture stove, tire and other bolts in considerable quantities. This company has a branch factory in Dayton, O. In the manufacture of bolts and nuts, this company employs the cold forging method. The officers of the company are Charles Glover, president; Clarence A. Earl, vice president; Theodore E. Smith, secretary and treasurer; William Surre, assistant secretary.

SECTION II.

PENNSYLVANIA.

THE ORIGIN AND GROWTH OF THE BOLT AND NUT BUSINESS IN PHILADELPHIA.

WILLIAM GOLCHER.
Philadelphia.

Mr. William Golcher, an Englishman from Darlaston, Staffordshire, England, commenced the manufacture of carriage bolts in the basement of the house in which he lived on Front Street, above Race, West Philadelphia (known in those days as Schuylkill Front, in the year 1840). He was assisted by his two sons, the younger a mere boy, who was employed working the bellows at his father's forge. Mr. Golcher introduced the English Oliver, a bolt forging machine, named after its inventor, Thomas Oliver, of the above mentioned town and county in England. It was imported and operated by Mr. Golcher. In construction it was quite different from those in present use. It was clumsy and cumbersome to operate. The casted anvil block was supported and held in position by and between two heavy perpendicular timbers deeply imbedded in the earth and securely fastened overhead. A framework was firmly bolted and braced to the back of these posts or timbers

in such a manner as to hold and allow adjustment of the axis or pivots of two large swinging hammers, both working between the supports and towards the front. The swinging hammers were operated in the usual manner, with back treadles, the downward pressure of the right foot on the treadles bringing them into action to strike the blows, and the spring poles overhead reacting and returning them to position for a repetition of strokes. By this means the hammers could be made to strike quite rapidly and with great force. The lever attachment, gauge and pimpler, passing up into the bottom of the bore for loosening and removing the bolts were very similar to those of to-day. On this machine a carriage bolt of ordinary dimensions could be forged complete with one heat, in the following manner:

First. By rounding the square rod to the required diameter and length with the heavy left side swaging hammer, thus leaving the right hand free to apply the water swab to remove the scale.

Second. The partly cutting off of the blank from the rod by a number of light blows with a hand hammer and hardy, the hardy being straight in front, slightly rounded on top, the concave running towards the back in a chisel shape so as to form a long conical point on the bolt by turning the rod while being struck and partially cut off with the light hand hammer. The uniformity of length of round and amount of surplus for head was assured by adjustable gauges arranged back of the swages and hardy.

Third. The blanks thus rounded and very nearly severed were well entered into the square bore and twisted off the rod by a slight turn or twist of the wrist, the stock being driven down with a few short quick strokes of the hand hammer, care being taken to raise the blank a little after each blow to prevent it from becoming fast in the die (or "bore"). This was done by striking a ("jumping lever") lever device gently with the points of a pair of tongs held in the left hand.

Fourth. The stock now being properly formed the large right side heading hammer having firmly keyed in its face a heading die (or "snapper") of the desired size and shape of head was brought into action, striking it several powerful blows. The jumping lever operating the stop gauge and pimpler beneath the bolt point being again struck correspondingly with the tongs.

Fifth. The bolt now being forged, was removed from the bore with a quick blow of the hammer on the jumping lever and the burr or rough edge around the head (frayed) was filed off while hot by holding the bolt with the tongs supporting it in a crotch-shaped tool held in the anvil.

This completed the process of forging carriage bolts on the first Oliver bolt forging machine in America. The heads of the bolts were then filed bright for the purpose of receiving a coating of paint, and were threaded with a screw plate. The nuts were made by the regular blacksmith's method and threaded with a plug tap and tap wrench.

Mr. Golcher experienced the same difficulties in the disposal of his goods as his Connecticut neighbor. His sales were so small that no inconvenience was had in delivering them with a hand basket. Mr. Golcher pounded away with his Oliver machine, his brain being busy in the meantime devising and planning improvements and new devices were added from time to time. In 1845 we find him in a new factory, driven by steam power, on Moyamensing Avenue and Tasker Street. His Oliver had been transformed into a modern-appearing machine, due largely to the handicraft of Jimmie Rogers. The timbers were replaced with a wrought iron frame keyed into T-shaped arms extending out and cast solid onto the back and end of the anvil block, the right side hammer working at right angles to the left, or back hammer as it is now called. Adjustable clip pivot bearings were affixed to the upright standards for the swinging-hammer axis to work in. A power screw-cutting lathe was in full operation, having a revolving, sliding spindle

within its shaft, held in position by means of a flat pin made fast in the inner shaft with either end working in the slotted driving shaft in such manner as to give free endwise movement of the inner shaft while in motion. To the front end of this sliding spindle was fitted a head or chuck having two jaws held in place by and working on pins passing through near its face, the rear ends being toggle-jointed to a circular-grooved movable collar attached to a hand lever by means of the groove in the collar, set screws, etc. In the front of these jaws were held a pair of holding dies, and the neck of a blank being placed between the holders, the collar was brought forward by means of the hand lever, thus closing them onto and forming a grip around the neck of the bolt, the necessary resistance being obtained from a coil-spring on the back end of the spindle. The hand lever was then brought forward against the pressure of the spring, forcing the movable spindle ahead until entering the point of the bolt in the threading dies, which consisted of two dies, the lower being stationary, and the upper held in a circular-moving weighted wooden hand lever, hinged at its back end and working in steady guides to a stop gauge for insuring uniform sizes of threads. The lever, resembling a bellows handle, was made in such shape as to enable the operator to stand erect, forming a straight line from the right shoulder down to the lever handle when under pressure. Power was applied to the lathe with the usual crossed and straight belts and reversed by a clutch sliding between the pulleys. The bolt required to be run up and backed off twice to finish the screw and the stopping of the lathe to remove and replace each bolt. It was known as the "little engine." From 1,000 to 1,200 bolts were threaded per day in this manner. The idea of this lathe originated in England, where it was used for cutting wood-screw threads. It is said to have been patented in Great Britain, and that at one time, the rights were sold for 10,000 pounds sterling. The reverse slide, or clutch, between the pulleys, like the tapping lathe, ran continuously on

a feather or square shaft, as the case might be. The motion was evidently copied after a similar arrangement on a weaver's loom. The holding clamps in the threading and turning lathes were originally tightened and loosened with a key-shaped socket wrench and set-screw. The three lathes mentioned were operated by foot power, until they were improved by Mr. Golcher, who also supplied them with steam power.

We also find power tapping and turning lathes. The tapping lathe, a very crude concern, was operated with the double belts and clutch, similar to the Rugg & Barnes' machine, except the nut holder and carrier which moved endwise to and fro on a dovetail slide gibbed to its bottom. The turning lathe, like all other bolt machines of this period, had the customary sliding clutch for starting and stopping, otherwise it was made up from the plan of the threading lathe. Its collar and lever attachments were constructed a little heavier and secured to a shaft firmly in a stronger lathe bed. The bolt, being reversed, was first placed in the holder, point first, and rigidly clamped by the neck, leaving the head clear of all obstructions. The turning was done with a tool patterned something after the style of a home-made box scraper fastened into a round wooden handle perhaps two feet long and having a short arm on its side, about eight inches from the front, in the form of an old-time scythe handle. The front end carried an iron eye and swivel jointed to a band encircling and fastened to the handle. The eye was hooked to a lug device projecting from the frame, the tool being operated by placing the long handle under the left arm and grasping the short one with the right hand. In this manner it could be made to work in any direction. The lathe revolved from the operator (left handed), the turning being done from above the bolt head by first commencing on the edge, then the chamfer, finishing with facing the top of the head. Previous to this, two tools were required, one as described and the other a triangular shaped tool, with three faces or cutting edges, fashioned much like an ordinary saw-

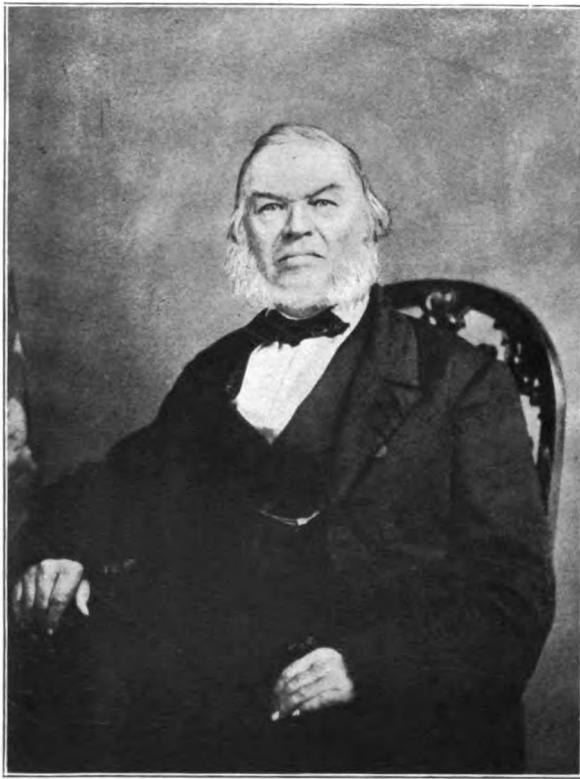
file, ground sharp towards the point, and fastened into a straight round wooden handle. In using this tool for turning or facing the tops of heads only, the motion of the lathe was reversed.

All carriage bolts in those days were made with bevel heads with flat tops. All of this had been accomplished in a few years by Mr. Golcher's persistent effort and ingenuity.

During the years 1846, 1847 and 1848 Mr. Golcher began the process of annealing and blueing by placing the bolts, in a circle on the ground after being threaded, with sticks of wood standing endwise over them which were burnt. He also commenced the turning of tire bolt heads, which, like his carriage bolts, were finished very nicely and tastefully. After annealing, the threads were brushed and oiled with linseed oil. Mr. Golcher named his bolts the Philadelphia Eagle bolts. Under this brand and for their excellent workmanship, quality of material and uniformity of finish his bolts gained and established a justly deserved world-wide reputation. In after years the name, with engraved cut of the eagle, "Philadelphia Eagle" bolts, was printed, and has been and now is used either in part or in whole on labels, quotations, price lists, etc., by nearly all the leading bolt and nut manufacturers throughout the country. This, or a similar trade mark, was copyrighted, however, by M. J. Coleman in 1865, and later, sold to the Upson Nut Co.

Owing to the increase of business and want of room Mr. Golcher was obliged to move into larger quarters on Dickerson Street in 1849, styling the new factory the "Phenix" Bolt Works. Here he carried on an extensive business, enjoying the fruits of his labor, until he passed away in 1876 in the fullness of years, surrounded by family and friends and respected by all who knew him.

After his death his sons conducted the business, removing to Reading, Pa., in 1879, where they continued under the firm name of Golcher Bros. until 1890.



William Golcher

The following letter replies to a request for information concerning the origin of the bolt business in Philadelphia.

READING, PA., May 9, 1887.

Dear Sir: In answer to yours of April 25, I will endeavor to give you the facts desired. My father first commenced carriage-bolt making in 1840 in the basement of the house in which he lived on Front Street, West Philadelphia. He built a new shop on Moyamensing Avenue and Tasker Street and employed steam power in 1845. Removed again in 1849 to Dickerson Street, above Second, and there remained until he died, December, 1876, at the age of 75. He operated ten Olivers, finishing about 50,000 bolts per week, including tire bolts, of which the blanks were purchased. After his death the firm's name became Golcher Bros., and removed to Reading in 1879, where we still continue the business.

Yours respectfully,
G. GOLCHER.

In introducing the Oliver forging machine, in America, Mr. Golcher built better than he knew. He not only encouraged the new and important bolt and nut making industry, which has since grown to such great proportions, but he was also instrumental in making it possible for many other branches of manufacturing to be successfully prosecuted by mechanics and others of limited means, and as a result numerous small factories were established for the manufacture of parts of firearms, carriage trimmings, horseshoe nails, locks, and numerous other articles of commercial value and general use.

WILLIAM GOLCHER.

Mr. William Golcher was bred in the land where the mechanical trades were carefully nurtured and reduced to a science. He was born at Staffordshire, England, in 1800. After serving his apprenticeship and learning the trade of

metal worker, he came to America and made his home in Philadelphia, where he engaged in making stamps and dies of various kinds, such as wooden stamps or moulds for ornamenting rolls of butter, and metal dies for embossing sheet iron stoves, alphabetical plates, etc. It is said that he originated the design of a sheaf of wheat for a butter stamp and other unique and popular ornamentations. In a few years he accumulated sufficient capital to embark in business on his own account. His first venture was to establish the bolt making business in the basement of his home, at the corner of Front and Race streets, in 1840. At this time he imported the first English Oliver forging machine ever brought to America. With this and other necessary implements he began making carriage bolts and introducing them to the trade. He soon found a ready market for his product, and in course of time his business increased and prospered, so that he was enabled to erect and equip a plant on Moyamensing Avenue. This was in 1845. Here he continued business until 1849, when he removed to a larger and more perfectly appointed plant on Dickerson and Second streets. Strict attention to the details of his business, firm integrity in all of his dealings and a constant effort to improve the product of his factory and secure for it a wider market were the salient characteristics that contributed to Mr. Golcher's uniform success. Not content that any "Pent up Utica should confine his powers" he sought markets in England and other foreign countries for his product, and it stands to his credit that he was one of the first, if not the very first, to establish a foreign trade for bolts and nuts manufactured in America.

Throughout his business life, Mr. Golcher was a recognized leader in his line of trade. As a business man and a stanch and useful citizen he stood among the foremost of his contemporaries. Mr. Golcher continued in business until his death, which occurred in his 76th year, on December 21, 1876, after

which the business was conducted by his sons, George and John T. Golcher, under the style of Golcher Brothers, who removed the works to Reading, Pa.

COLEMAN BROTHERS.

Philadelphia.

How they became Leaders of the Bolt Business. Importation of Bolts made by Cheap Labor of Europe.

The second successful parties to enter the bolt and nut field in Pennsylvania were Ebenezer Coleman and his brother Philoman, natives of the same place as Mr. Golcher, Darlaston, Staffordshire, England. The Colemans commenced business with one old style Oliver, in 1845, under the firm name of E. & P. Coleman Bros., in a cellar on Market Street, near Twenty-first Street, Philadelphia, using the same class of tools and mode of manufacture as their fellow-countryman, Mr. Golcher, delivering their goods with a hand cart in the evenings, to save time. In 1848 they removed to quite a large two-story building on the corner of Twenty-first and Cuthbert streets, using steam power and making various improvements. The thread cutting dies of Mr. Golcher's threading lathe were made to close horizontally by a right and left hand thread device, operated by a hand wheel. The right and left screws were soon replaced with spiral cams, for the purpose of obtaining quicker action in closing and opening the dies. The cams were superseded by the solid threading die having three cutting edges. Fifteen Olivers of Jimmie Rogers' new pattern were kept in operation. "Jimmie Rogers" was an ingenious and handy carpenter, employed by Golcher & Coleman to make patterns and to do odd jobs in the factory. He originated several valuable improvements, conspicuous among which was that of transforming or Americanizing the

“Oliver” and greatly increasing its utility. The custom of tying a sample bolt on the outside of the package across the label came into vogue. The manufacture of fancy bolts, such as shaft, cone and steeple heads was introduced, which rapidly grew into favor and became an important branch of the bolt industry.

In 1850 the Colemans were in possession of a tire bolt heading machine, which made tire blanks automatically, taking the wire directly from the coil, shearing it off and forming the head at one operation. This machine was purchased together with entire machinery of a small wood screw factory near Paterson, N. J. Where this machine originally came from or who built it is not definitely known, but from the description given by those familiar with its construction and operation, it is presumed that it was built by and purchased from the Sanscar Machine Company of Middletown, Conn. It was a large cumbersome machine, constructed with a heavy, long, narrow square ended bed, carrying a ponderous round-rimmed balance wheel, with a wooden driving pulley bolted to the outside of its S-shaped spokes. The driving shaft passed under the middle of the bed revolving a huge cam of the rolling mill shear variety. This cam operated the plunger slide by raising a massive toggle joint attached to the back end of a large round plunger slide (6 or 8 inches in diameter) and rear inside end of bed, the blow being struck by straightening the toggle joint towards its horizontal center line, thus forcing the heading die forward to form the head, the dies being closed with a wedge attached to the round plunger slide. The wire was fed into the machine through a tube with the ordinary feed rolls, pawl and ratchet operated by a cam on the driving shaft between the hub of the fly wheel and frame, working the ratchet and rolls vertically. The ratchet teeth were quite fine, requiring not less than seven pawls to insure accuracy in feed, there being no gauge. The dies were held in position by movable slides with studs, nuts and buttons, adjustment being by

blocking. The blanks were cut off by closing the dies on the wire, forcing them past the shear with the wedge to an adjustable stop and holding them firmly while the forward motion of the plunger formed the head, when the dies were returned to position by means of a spring and the blank was thrown out by the incoming wire. The heading die was adjusted with a long taper key passing through the large round plunger slide by driving it up or down with a sledge hammer. This was a most remarkable machine in its day, and it appears to be the second of the kind made use of in a bolt factory to manufacture tire bolts. It headed $\frac{1}{4}$ and 5-16 diameter by 3 inches long with ease at the rate of 65 per minute.

Russell, Burdsall & Ward were the first to use a wood screw heading machine or the principles involved for making tire and stove bolts. Prior to 1850, very few tire bolts were made by machinery. Plant & Co., and perhaps one or two others, had purchased tire blanks made to order from the screw works at Middletown, Taunton and Hartford.

The rapid growth of business obliged Coleman Bros. to secure more room and facilities in 1851; hence they moved into a large convenient three-story building, having several wings, on Arch, between Twentieth and Twenty-first streets, in the then unsettled part of the city. The threading lathe was again improved by incorporating the Martin Barnes' method, doing away with the sliding shaft, changing the solid die from stationary to a revolving die, fastened into a suitable chuck, secured to the end of the shaft, in place of the former bolt holder. The bolt was now held by a niche in a holder, bolted to a flat, endwise movable slide, having a chain attached underneath its center, passing either way over small shieve pulleys to a treadle, which was used to carry slide forward to enter the bolt in the die, a weight returning it to position for repetition of the operation. The lathe was operated with two treadles, one as described and the other for shifting the clutch to reverse the machine in backing off.

About this time the manufacture of whiffletree bolts was commenced, followed shortly after with step, dash, perch, acorn and ball head bolts.

During the fifties, the Colemans made several attempts to forge bolt heads by machinery operated by power, but met with very little success, until late in the fall of 1858, when they purchased a Chapin heading machine and immediately commenced the heading of long lengths of carriage and tire bolts, which were first rounded by Olivers. This created much dissatisfaction among the bolt makers, who threatened serious trouble by inaugurating a strike against the use of the machine. Peace was soon restored, however, when it was fully explained that long lengths only were to be headed on the new machine and the Oliver rounders were given a small increase in wages. In those days bolt making included nut making and was considered a valuable trade, and to learn the bolt maker's trade required an apprenticeship of several years' duration. The laws of Pennsylvania were very strict in this relation. Boys were required to be what was termed "bound out" until 21 years of age, to learn any trade, and agreements to that effect were drawn and signed by both parties. The employer gave what was called "Indentures," which prescribed, on the part of bolt makers, that they were to pledge themselves to impart, learn and teach to their apprentices all of the arts and mysteries of the bolt and nut business, and the apprentices were obligated to continue and to persevere until they became thorough masters of every branch of the trade.

During 1859 or 1860 Mr. Philoman Coleman went to England and began shipping bolts and nuts to the home works in Philadelphia. These bolts and nuts were made largely by women and children in small shops, mostly located at Staffordshire. These shops were part of dwelling houses or built in the yards of bolt makers. Their mode of manufacture was to employ the child to work the bellows for the

father, while the wife and mother or grown-up daughters cut the thread and in many instances forged the nuts at the anvil, they becoming more expert on small work than the men. This manner of bolt making is said to still prevail in certain parts of England at the present day. Bolts made by this method at that period were purchased very cheap, and no doubt netted Coleman Brothers a handsome profit in the market of this country. At all events they continued to increase their importations. On March 2, 1861, Congress imposed a duty of 30 per cent. ad valorem on these articles. By an act of July 14, 1862, the duty was increased 5 per cent., making it 35 per cent. ad valorem on bolts and nuts. The increase made no material difference, as these acts simply covered finished goods and were easily evaded by importing bolts that were neither threaded nor turned, and importations continued on a larger scale than before. Unfinished bolts were imported by the shipload, so to speak, coming as ballast, and in barrels marked "spikes," "shutter rivets," etc., until the New England manufacturers demanded more and better protection. Congress again, in 1864, in lieu of the above, placed a duty of 2 cents per pound on iron or steel nuts with or without washers and $2\frac{1}{2}$ cents per pound on iron or steel bolts with or without threads or nuts, and the same on bolt blanks. These rates have not been altered or amended since and are still in force. This last act, changing the per cent. ad valorem to cents per pounds struck directly at the importation of bolts and nuts partly finished. But at this time and for several years after it had no visible effect in stopping the traffic, but eventually with the aid of improved machinery and cheapened production proved prohibitory.

For example, the piece work price paid for hand made nuts in 1864 was $\frac{1}{4}$ and 5-16 bolt size, 16 cents per 100 nuts and 30 per cent. extra per dollar. There were 100 $\frac{1}{4}$ inch nuts to the pound, and 50 5-16 or 5,000 and 10,000 nuts per 100 pounds, costing in labor for production per 100 pounds,

\$10.40 and \$19.80 respectively, while in 1872, or eight years later, the piece work price paid for the very same sizes and weight were per 100 pounds, made by machinery $\frac{1}{4}$, \$1.65; 5-16, 80 cents; mark the reduction!

The reduction in the production of bolts was proportionately the same, which made the prevailing tariff positively prohibitive in after years.

Although Coleman Bros. continued to import large quantities of unfinished bolts, it appears that no serious complaints were made until after the close of the war, when the return of the soldiers produced a surplus of labor. This brought about a powerful organization known as the Bolt and Nut Makers' Protective Union of Philadelphia, through whose exertions the importation was decreased in a large measure, as Congress was appealed to through representatives of several districts, and a committee was sent to Washington to remonstrate in person. The Custom House officials were made to comply with the rules, which had a tendency to lessen the traffic. After a long and hard fight the bolt makers succeeded in shutting out all foreign made bolts and nuts, but not, however, until after the death of Philoman Coleman in 1870.

About 1862 Mr. Wm. H. Hubbard, a native of New London, Conn., entered the bolt arena, going to Philadelphia from Morrisiana, N. Y. Mr. Hubbard proved to be a man of genius. He was dubbed "Yankee Pat" by the bolt workers. Shortly after Coleman Bros. occupied their large factory on Arch Street, the vicinity began to fill up with fine residences, and eventually became a prosperous neighborhood. As a matter of course the smoke, noise and greasy smell of the bolt works did not exactly correspond with their aristocratic ideas of beautiful avenues and magnificent mansions, and as a natural consequence steps were taken towards the removal of the factory by declaring it an abominable nuisance. The municipal council and every available court

of justice was appealed to, witnesses were subpoenaed by the hundred, but all efforts proved fruitless. Coleman & Bro. held their ground by virtue of pre-occupancy.

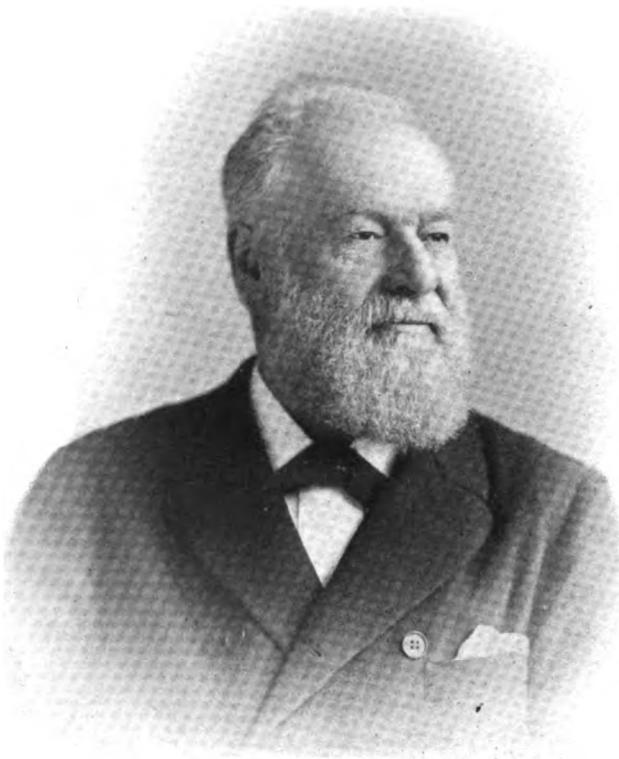
The following good story is told of Mr. Hubbard's advent in Philadelphia. During one of Mr. Coleman's visits to Morrisiana, N. Y., in 1862, he saw or heard of a swaging machine invented by Mr. Hubbard, for rounding bolts. It was built upright, on the trip hammer plan, having a board spring resting on the top of the hammer bar. The bar was lifted with a revolving shaft, having a number of cam lifts, and was forced down to the work with a quick motion by a spring board. It run very rapidly and made a most terrific noise. Mr. Hubbard called it his "rattler." This was without question a very appropriate name. It is said that when Mr. Philoman Coleman saw this machine, he looked at it, listened to it for a few minutes, and then raised his good right hand aloft and exclaimed: "Great guns! if that machine can be bought at any price it shall go to Philadelphia and tickle my neighbors' ears." Whether this story be true or not, the "rattlers," twelve in number, were placed in Coleman's factory, where they created the most dreadful and discordant noise imaginable. Mr. Hubbard accompanied them and soon became a part and parcel of the bolt and nut business of the Quaker City, to the success of which his inventive powers largely contributed. His inventions and improvements were numerous and important.

The Colemans adopted the Seller's thread (Franklin Institute, or United States Standard), thereby securing large orders from the United States Government, which gave them quite a boom, coupled with a good reputation. A powerful tire blank heading machine was added to their already large supply of machinery, which headed 5-16 and $\frac{3}{8}$ tire bolts automatically from the coil. It is stated on good authority that Coleman Bros. employed the Koch forge nut machine

for making nuts for which they paid for the right of Pennsylvania the neat little sum of \$50,000.

In 1865 or 1866 they commenced to upset "stove up," bolt blanks, hot, on a Lewis, Oliver & Phillips heading machine, built in Pittsburgh. In 1873 Billy Hubbard introduced his cold staver, "upsetter," a self feeder, making the bolt blanks automatically from the coil or reel of cold wire. This machine completely revolutionized the Oliver system of bolt making. Had it not leaked out, or rather had not Mr. Hubbard's ideas became known until after the principles and design of this machine could have been covered with letters patent, he might have realized an immense fortune from its marvelous production, for not only by the use of this machine was the cost of forging reduced to nearly one-half, but the bolts were much better made, having a finer appearance, smoother and more perfectly finished. As it was, other bolt makers, always on the alert for new and valuable improvements, by some hocus pocus, got possession of Mr. Hubbard's plans and applied them to their tire headers, thereby anticipating or antedating him, by several months, this being done while his upsetter or "staver" was in the course of construction.

Ebenezer Coleman passed away in 1861, the city losing a mechanic of rare abilities. Philoman died in England in 1870, the recognized leader of the bolt business in Philadelphia. Very soon after the death of Philoman, Mr. Moses James Coleman appeared at the head of the concern. In a short time it fell into the hands of George De B. Keims, the well-known hardware dealer, who purchased it for \$40,000. It soon after changed hands again, and became the property of the firm of Welch & Lea.



BARTON HOOPES.

Founder of the firm of Hoopes & Townsend
Born, July 11, 1827; died, November 15, 1895

PENNSYLVANIA AGRICULTURAL COMPANY.**York.**

The Pennsylvania Agricultural Co. of York, Pa., was established in 1846. They introduced the manufacture of bolts and nuts, solely for their own consumption, and still continue the manufacture to a considerable extent, but not in sufficient quantities to supply the demand of their own factory, because they find it more profitable to purchase the bulk of their supply from factories that make a specialty of that line of business. The style of the company is A. B. Farquhar & Co., Limited, Pennsylvania Agricultural Works. The officers of the company are A. B. Farquhar, chairman; W. E. Farquhar, vice chairman; Francis Farquhar, superintendent.

NEFF & SON.**York.**

In 1878, Neff & Son, carriage builders of York, Pa., added a bolt and nut department to their factory with a view to supplying their own demands. The experiment proved unprofitable, but it was continued for nearly three years.

HOOPES & TOWNSEND COMPANY.**Philadelphia.**

Messrs. Hoopes & Townsend commenced business on Buttonwood Street with very moderate means, making the manufacture of cold pressed nuts a specialty and soon became leaders in this branch of industry, steadily advancing and increasing their facilities until at the present writing their works are probably the largest of the kind in the United States, if not in the world. They occupy nearly an entire block. In the various shops some 500 hands find steady

employment; but were it not for the improved labor-saving machinery, with which every department is bountifully equipped, 4,000 skilled artisans could not produce goods equal to their present demand. In addition to their Buttonwood Street plant, Hoopes & Townsend Co. have a large factory near Chalfont Station, on the Philadelphia & Reading Railroad. This plant was built in 1902, and is chiefly devoted to the heavier lines of forging. About it has grown up a considerable colony of working people connected with the factory, and this settlement has been named Oreland.

The business of making bolts, nuts, washers and kindred articles by machinery, in connection with the firm of Hoopes & Townsend Co., was commenced in Wilmington, Del., in the year 1849, by the senior partner, Barton Hoopes. Early in the year 1850 he became associated with S. Sharpless Townsend, under the firm name of Hoopes & Townsend.

Believing that a large city presented better facilities for shipment, as well as superior advantages for local trade, the machinery was removed to Philadelphia, in July, 1852, when Edward Hoopes became a member of the firm.

In the distribution of the business, Edward Hoopes took charge of the financial and business department, while the duties and details of manufacturing were assigned to Barton Hoopes and S. Sharpless Townsend, the latter devoting much of his time to the construction and improvement of the machinery.

In July, 1875, Edward Hoopes retired, after an active service of twenty-three years. His energies and talents were assiduously devoted to the interests of the firm during his connection with it, and he retained in his retirement the highest regards of the remaining partners.

After the dissolution, Barton Hoopes and S. Sharpless Townsend formed a new co-partnership, retaining the firm name, and Mr. Townsend assumed control of the financial and business department.

Their list of manufactures embraced car, machine, plow, and button-head bolts, cold punched nuts, "Keystone" boiler rivets, tank and copper rivets, washers, split and single keys, coach and lag screws, punched chain links, elevator and carrier chains, boiler patch bolts, truck sides, car forgings, railroad track bolts, bridge rods and bolts, rods, bolts and irons for buildings.

The success which has attended this firm in placing before the public their various articles of manufacture, is the result of careful selection of the iron used (much of which is made expressly to their order), their improved machinery, and their close attention to the details of the manufacturing department. These features enable them to place a thorough reliance on the quality and finish of their goods, and fully justify them in presenting them to their patrons as first-class products. The following, from a local print, gives a graphic account of the magnitude and character of the business of Hoopes & Townsend some thirty odd years ago:

"A few yards east of the great Corliss Engine in the Centennial Exposition of 1876 was an exhibit that was to all iron-workers one of the most interesting in Machinery Hall. It was a display of bolts, nuts, etc., made by Hoopes & Townsend, of Philadelphia.

"A square pavilion of neat and tasteful design, constructed throughout of polished walnut, inclosed a floor space of over three hundred square feet, with a height of eighteen feet. To its sides were attached bolts and nuts of every conceivable form and size; iron railroad car trucks and forgings for buildings; flat-link chain for elevators, etc., all artistically arranged, so as to strike the eye in the most pleasing manner. On the floor of the space (which was covered with a rich velvet carpet) was a series of bins filled with the varied manufactures of the firm, in order that they could be handled and critically examined by those interested in

this class of goods. The design of one of the walls of this inclosure is worthy of special mention. The initial letters of the thirteen original States formed an arch. These letters were formed with bolts and the arch was outlined with a flat-link elevator chain. The keystone of the arch was formed of bolts and rivets. The keystone is the copyrighted trade-mark adopted for these rivets, and the whole formed a design at once appropriate and effective.

“ While examining these goods, which appeared to have reached a high state of perfection in workmanship and finish, the attention of the visitor was drawn to a beautiful nickel-plate nut. This nut was neatly finished and stamped on the sides with the names of the different articles manufactured by the firm, and was sent out to serve the double purpose of a paper weight and an advertisement. Its peculiarity did not consist in the beauty of its finish so much as in the display of ingenuity and skill which must have been exercised to punch it. It was one and three-quarters of an inch in thickness and punched cold with a hole only seven-sixteenths of an inch in diameter. Feeling curious to see the works which produced this marvel, for such it is conceded to be by all, we visited the manufactory and were courteously allowed to witness the process by which it is accomplished, a privilege seldom accorded to any person outside of their employ, this precaution being necessary to secure to themselves the sole advantages of their admirable machinery, most of which had been built on the premises. We saw a seven-sixteenth punch go through a bar of cold iron an inch and three-quarters thick, as noiselessly and neatly as if it had been a bar of lead.

“ To the general reader, not skilled in mechanics, this undertaking can best be appreciated, when we add that it has always been considered that if a punch made from the best steel and hardened in the most approved manner could be forced through a bar of cold iron as thick as the diameter of the punch, it had done all that it could do, or in other

words, that a bar any thicker than the diameter of the punch would offer so much resistance as to cause the punch to break. Such has heretofore been the experience of our most skilful mechanics. In this case we have a bar of iron punched cold, four times the thickness of the diameter of the punch, thus showing what can be accomplished with known force, so far exceeding the powers usually attributed to them. Messrs. Hoopes & Townsend are entitled to almost as much credit as if they were the discoverers of a new patent. The thought and ingenuity necessary to the accomplishment of a feat of this kind has shown itself in all the different manufactures of this firm, many of which are worthy of special mention. Among them is the railroad track bolt, the peculiarity of which consists in the manner of cutting the thread and adjusting the nut. This is done in such a way that when the nut is wrenched up to its place, the accuracy of the fit prevents its jarring off by the action of passing trains. The 'Keystone' boiler rivets are made in solid dies, and are unequaled in quality. The nuts, both square and hexagon, are made from the best material, have fairly centered holes and are of excellent finish."

These extracts will be followed with a discussion and tests by and between Messrs. Hoopes & Townsend of Philadelphia and J. H. Sternbergh & Son of the Reading, Pa., bolt and nut works, wherein both parties endeavored to prove the relative superiority of hot and cold pressed nuts. The tests were conducted by Prof. R. H. Thurston, director of the Mechanical Laboratory of the Stevens Institute of Technology at Hoboken, N. J.

INSTRUCTIVE TESTS.
Of Cold Punched and Hot Pressed Nuts.

The following letter appeared in the Philadelphia Polytechnic Review of October 14, 1876:

Gentlemen: In the issue of your paper of August 26, there appeared a notice of the "Centennial" exhibit of the Reading Bolt & Nut Works.

There are several items in the article to which, with your permission, we desire to take exceptions.

The first paragraph we notice reads:

"Nuts punched, cold, unless subsequently repunched or drilled, have a ragged hole, the fibers of the iron being more or less disintegrated and broken in the process of punching, especially after the piercing punch has penetrated one-third or one-half the way through." When we commenced the manufacture of cold punched nuts, some twenty-five years since, there were more or less of the fibers disintegrated in the process of punching, but after an experience of a few years, by the use of improved machinery, we overcame this difficulty. We now punch holes in cold iron as smooth and as perfect as those punched in hot pressed nuts, and an examination of the holes in nuts made by us will show that there are no loosened fibers, and it can also be seen that the holes are no larger one way than the other. Another paragraph reads: "In cutting the threads in cold-punched nuts the tap frequently loosens the broken fibers and they crumble out with the tap, and the thread is found broken and imperfect, especially in the center of the nut." We make a broad denial of this assertion, regarding nuts made by us. We have tapped about three tons of cold-punched nuts per day at our works, and we are never obliged to condemn one on account of the thread falling out. Indeed, we can assure you that the threads as tapped by us are quite equal, for all practicable purposes, to threads chased by lath-work. An examination of the tapped nuts at our exhibit in Machinery Hall, or of those as sold by us, will convince any one of this fact. Nor do we have any complaint in this respect from any of our numerous patrons, and we should be glad to refer to any one of them for an opinion.

Another passage reads: "In the methods of punching hot pressed nuts, the fibers of the iron around the hole in the nut are left undisturbed, and the thread when cut is found to be perfect, and of the utmost strength that the iron will admit." This might lead some to conclude that the opposite of this statement is the truth in reference to cold-punched nuts. A few weeks since we had some tests of the relative strength of cold-punched and hot-pressed nuts, made by Messrs. Riehle Bros., on their testing machine. We cut seven (7) pieces of iron and three (3) pieces of steel with the "Hoopes and Townsend" thread and placed on either end of each a hot-pressed and a cold-punched nut, properly tapped, of one-half the standard thickness. In each test the thread of the hot-pressed nut was stripped by the rod, while that of the cold-punched nut remained firm and unbroken. The hot-pressed nuts used in these tests were made at the Reading Bolt & Nut Works.

We do not hesitate to say that we are prepared to give the best possible proof that the cold-punched nuts made by us, when properly tapped, are stronger than any hot-pressed nuts made.

It is so asserted in the article alluded to that "the holes in cold-punched nuts are not punched at right angles to the top and bottom of the nut," or, in other words, the holes in cold-punched nuts are crooked. Such is not the fact in regard to the nuts of our manufacture. There is always a slight concave and convex surface in the cold-punched nut, but the hole in the "Hoopes & Townsend" nut will be found at direct right angles, and the bearing is quite as perfect as that of the best hot-pressed nuts.

In punching a nut of cold iron, the hole is left entirely free from any scale or crust, nor is there the least obstruction to the free cutting of the tap. In the holes of the hot-pressed nuts there remains a hard and brittle scale, which takes off the fine cutting edge of the tap, and the gauge is soon lost.

We have tapped several tons of cold-punched nuts at our works with one and the same tap, without loss of gauge or permanent injury to the tap. The cold-punched nut is more readily finished than the hot-pressed nut, and the "chamfer" on the finished nuts as made by us is perfect and uniform, and is also more full and regular than the finish on a hot-pressed nut.

The views expressed in the article in reference to nuts of hot and cold manufacture may be yours, or may be those of the manufacturer himself, but in either case we thought best to notice them in this manner. The reputation of our manufactures was brought in question, and we never lose an opportunity to defend the result of our careful attention to the production of these goods.

Very truly,

HOOPES & TOWNSEND.

THE TESTS.
Of Cold-Punched and Hot-Pressed Nuts.

The following are the results of a determination in the mechanical laboratory of the Stevens Institute of Technology of the resistance to stripping and to bursting of several sets of hot-pressed and of cold-punched nuts. They were of four sizes, viz., $\frac{1}{2}$ inch, $\frac{5}{8}$ inch, $\frac{3}{4}$ inch and $\frac{7}{8}$ inch bolt size. The hot-pressed nuts were made by J. H. Sternbergh of Reading, and the cold-punched nuts by Messrs. Hoopes & Townsend of Philadelphia. The conditions of the trial were:

That all the nuts to be tested be suitably marked and a record kept of the number of marks of each sort.

That those for tapping be examined to see that the sizes of holes are exactly the same as agreed upon, viz., Franklin Institute standard.

That all nuts of a given size which are to be tested by stripping the threads, be tapped with the taps furnished by Messrs. Sellers & Co.

Directions for the tests of the stripping of the threads of the nuts: Take 120 rods as follows: 30 each $\frac{1}{2}$ inch, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, full diameter, all to be thirteen inches long, cut threads on each end one inch, first, however, turning down the fullness of the bar to exact diameter, a distance of two inches on each end; these rods to be made of the best chromo steel, and nuts to fit as closely as possible, the makers of the taps to furnish the rods, provided you have not the facilities for doing so. These 120 rods are to be used as follows: Twelve of each size, viz., $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$ and $\frac{7}{8}$, one end to have a nut from Hoopes & Townsend's stock and the opposite end to have a nut from J. H. Sternbergh's stock; nine of each size, viz., $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, one end to have a nut from Hoopes & Townsend's iron, cold-punched, and the other end with Hoopes & Townsend's iron, made hot-pressed; nine of each size, viz., $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$ and $\frac{7}{8}$, to have a nut from J. H. Sternbergh's iron, made cold-punched and a nut from J. H. Sternbergh's iron, made hot-pressed.

That the tapped nuts to be used on rods in preceding clause are to be trued up accurately on the side on which the punch entered the nut. One-half inch nuts turned down to $5-16$ inch thick, $\frac{5}{8}$ to $\frac{3}{8}$, $\frac{3}{4}$ to $7-16$, and $\frac{7}{8}$ to $\frac{1}{2}$.

That a cold and hot-punched nut be placed on opposite ends of the same rod, with their finished sides facing each other, and submitted to a pulling strain in the testing machine, with such clamps holding each nut as will secure a uniform strain on the face of each nut equidistant from the center of the bolt, that the nuts so arranged be drawn asunder until the rods break or the thread in one or both of the nuts gives way. If the rod breaks before the nuts strip, then in subsequent tests the nuts are to be turned down on the side mentioned until they are thin enough to strip their threads

without breaking the rod. Should one nut only strip the thread, then the remaining nut to be subjected to a strain by clamping the shank of the rod and pulling on the remaining nut until it strips or breaks the rod.

That a record be kept of the stripping, breaking or bursting strain in all cases.

No rod or nut to be used a second time, except as stated in a preceding paragraph.

In all cases the nuts are to be pulled in the direction in which they are punched, or vice versa, only both makes alike.

A second test is to burst the blank nuts asunder by forcing them on a round, conical mandrel until they burst quite open, a record to be kept of the strain required to force the nut on the mandrel, and the distance it travels from the point where the nut is first tight until it is found to be burst open.

The mandrels to be used for test in the preceding paragraph are to be made of cast steel, and the following dimensions are proposed: From the small end to the center to be large enough to enter hole of nut, allowing nut to slide on mandrel one-half of its length, the conical part to increase in diameter about $3\frac{1}{16}$ of an inch in 6 inches; the taper part to be polished smooth and oiled, and wiped clean before each test.

The diameter of holes, thickness and outside short diameters of the nuts to be drifted, to be exactly the same.

The three qualities of nuts made by each contestant to be tested in this manner by bursting both blank and tapped, say 12 of each, or 72 blank and 72 tapped, making 144 in all.

Of each size six sets of nuts were tested as follows: Hot-pressed nuts made expressly for the trial by J. H. Sternbergh from iron furnished by him; hot-pressed nuts by J. H. Sternbergh from iron furnished by Hoopes & Townsend; cold-punched nuts by Hoopes & Townsend from iron furnished by them; cold-punched nuts by Hoopes & Townsend from iron furnished by J. H. Sternbergh; hot-pressed nuts chosen at

random from stock of J. H. Sternbergh; cold-punched nuts chosen at random from stock of Hoopes & Townsend. These nuts were received here in the form of blanks and in the condition in which they were left after punching. They were all hexagonal, and of the following dimensions:

	$\frac{1}{2}$ in.	$\frac{5}{8}$ in.	$\frac{3}{4}$ in.	$\frac{7}{8}$ in.
Distance between parallel sides..	.885	1.069	1.254	1.45
Diameter of hole.....	.3986	.505	6.105	.726
Diameter of hole after tapping..	.4056	.5143	.623	.733

TRIAL BY STRIPPING STRESS.

The nuts for this test were taken at random from the sets received, and were carefully tapped with a set of taps of Franklin Institute standard, made to order for the Mechanical Laboratory by William Sellers & Co.

The same set of taps were used for both the hot-pressed and cold-punched nuts. After tapping, the nuts were faced down to thickness which a preliminary series of experiments had shown to be, in each case, the thickness which would allow all nuts to retain a resistance to stripping slightly less than the tensile resistance of the screwed rod on which they were placed when applying the load. The following were the thicknesses:

$\frac{1}{2}$ inch.....	$\frac{1}{4}$ inch thick
$\frac{5}{8}$ inch.....	$\frac{1}{4}$ inch thick
$\frac{3}{4}$ inch.....	5-16 inch thick
$\frac{7}{8}$ inch.....	13-32 inch thick

The nuts were faced on the bottom side only (upon the side at which the punch entered) upon mandrels received from the manufacturers. Except in facing and tapping, no change was made in the dimensions of any part of the nut. After facing, the nuts were carefully paired off upon screwed rods, and tested in the manner described in the conditions of tests.

The rods and nuts as described were arranged in hanging blocks of the testing machine, the chucks being steel sleeves

slipped on the rod behind the faced ends of the nuts and fitting the sleeves with holes of $\frac{1}{2}$ inch, $\frac{5}{8}$ inch, $\frac{3}{4}$ inch and $\frac{7}{8}$ inch diameter used in the test of the nuts of those sizes respectively. All of the nuts were tested with their faced sides in contact with the steel sleeves.

The result of the test was carefully observed and numbered on the cold-punched and hot-punched nuts respectively, for the purpose of convenient reference to the nuts which were tested upon the same rod.

TRIAL BY BURSTING STRESS.

The tapped nuts used in this test were tapped with those used in the trial by stripping. The blank nuts were chosen at random from the lots received. The nuts were faced to the following thickness, which were in each case the greatest obtainable from the thinnest nuts received: $\frac{1}{2}$ inch were .44 inch thick, $\frac{5}{8}$ were .68 inch thick, $\frac{3}{4}$ inch were .72 inch thick, $\frac{7}{8}$ were .72 inch thick. It was expected to use a thickness for the $\frac{7}{8}$ nuts proportional to the thickness of the other sizes, but in consequence of one of the hot-pressed $\frac{7}{8}$ lot being unusually thin, the thickness of all was made .72 inch.

As in the case of the stripping trial the nuts were faced on the bottom side only, and, except in this respect and tapping, were not changed in dimensions. The tests were made in a Riehle tension machine.

The tests were conducted as follows: The mandrel was well coated with a lubricating compound of plumbago and grease, and the nut, with the faced side down, slipped on until it came to a bearing. From the cylindrical end of the mandrel to the faced side of the nut was read off, and the mandrel then arranged in the upper and lower pulling blocks of the testing machine, a solid steel socket being substituted for the stripping chucks. The $\frac{7}{8}$ and $\frac{3}{4}$ nuts bore directly against the bottom of the sockets. The $\frac{5}{8}$ -inch and $\frac{1}{2}$ -inch nuts bore against steel washers inserted between them and the socket.

After rupture, the mandrel, with the nut undisturbed upon it, was removed from the machine, and the distance from the small end again taken. The nut was then driven loose so as to allow it to spring together and the distance taken a third time, after which the nut was removed from the mandrel and a fresh one substituted.

The following observed results of the trial as given under the heading Bursting Stress are the actual average loads in pounds applied to the mandrels to produce rupture:

Out of 180 nuts tested by stripping stress only one hot-pressed nut broke under a greater load than the cold-punched tested on the same rod.

The average of the stripping or breaking resistance and of the bursting resistance of any of the sets of the cold-punched nuts is greater than that of any of the classes of hot-pressed nuts of the same size.

Out of the twelve lots tested by stripping the minimum resistance of the cold-punched nuts exceeds the average resistance of the hot-pressed of the same size and class.

In twenty-one out of twenty-four lots tested by bursting stress, the minimum resistance of the cold-punched nuts exceeds the average resistance of the hot-pressed nuts of the same size and class, but in one case *it is less than the average* and minimum of every other set and size.

In five cases of stripping the minimum resistance of the cold-punched exceeded, and in two equaled, the maximum resistance of the hot-pressed of the same size and class.

In eleven cases of bursting the minimum of the cold-punched is greater than the maximum of the hot-pressed of the same size and class, but in one case the maximum resistance of the hot-pressed nut exceeded that of the cold-punched.

The amount by which the average resistance to both stripping and bursting of the cold-punched exceeded those of the hot-pressed varied irregularly with the size, but may be regarded practically independent of the size of the range tested.

For the same material the amount of the excess of the average resistance to stripping of the cold-punched over that of the hot-pressed varies from 14.6 to 25.1 and averages 19.7 per cent. of the latter.

The amount of this excess for the bursting test varies from 6 to 75.7, an average of 51.9 per cent. of the resistance of the hot-pressed for the blanks, and from 10 to 41.6 with an average of 24.3 per cent. for the tapped.

WELCH & LEA.
Successors to E. & P. Coleman Brothers.
Philadelphia.

This firm continued the business for twenty years with notable success, and extended their business to European and other foreign markets. They established a continental agency in France, with magnificently furnished offices on the Faubourg, St. Honore, Paris, and reached the zenith of their glory during the great international exposition in the French metropolis in 1889. Their business career, though brilliant while it lasted, was doomed to oblivion during the nineties. An obvious lack of mechanical skill in producing improved machinery and a lapse of business tact and energy caused an ebbing of the tide of their apparent prosperity and forced them to finally suspend, confessing at the time that the western hustlers were too much for the eastern competitors. When their concern was closed a large share of the machinery was sold to The Columbus Bolt Works, Columbus, Ohio, and the remainder to the enterprising Upson Nut Company of Cleveland.

THOMAS AND WILLIAM SHIELDS.
Philadelphia.

The Keystone State became the Mecca of the bolt and nut business, which was centralized in the city of Philadelphia,

where numerous enterprises in the line were established, from time to time—a number destined to survive and prosper, but many more were born to flourish for a brief space of time and then to find their way to the “scrap pile” of enterprise, so to speak, or to be subjected to the stern mercy of the sheriff. Success and failure were constantly alternating, during the evolution of the bolt and nut business in America, and the failures by far outnumbered the successes.

In the year 1851, an English gentleman, named Duffield, furnished an example of the ups and downs of the bolt and nut business. He began manufacturing in a small way at a shop located on New Market Street, Huntington District, and continued in business about one year, when he sold out to Thomas and William Shields, who continued the business until 1857. Then they moved to larger quarters on Haydock Street, West Philadelphia. Here they built up a prosperous trade, which they enjoyed until 1863, when they dissolved partnership and Thomas Shields took charge of the concern and managed the business at the old stand until 1867. Then he removed to Pennsylvania Avenue and styled his works The Union Bolt Works. It was at this factory that women were first employed in the manufacture of bolts and nuts, on this side of the Atlantic, an experiment that proved economical and advantageous. Thomas Shields managed the business until 1880, when he removed to Newark, N. J., and continued bolt and nut manufacturing.

After the dissolution, William Shields went to Beverly, N. J., where he purchased at a low price, a large factory building that had been designed for a fruit canning works. He organized a business that proved so unprofitable that he disposed of it at the end of two years, and returned to Philadelphia, where he located, on Twenty-third Street, near Race Street, what he called “The Girard Bolt Works.” He continued this business with varying success until 1883, when he closed out the concern entirely.

It was in this factory, during 1880, that water solution was introduced through a hollow shaft to take the place of oil in cutting threads. The cutting lathe shaft was bored out and the solution pipe was attached to the rear end. The solution was forced through the opening with a pump, thus constantly washing the threading dies and clearing them of chips and foreign matter, an operation that proved highly successful, as it lessened the cost of labor and materially increased production.

MAHONEY & SHIELDS.

Philadelphia.

Messrs. Michael Mahoney and David Shields opened a small bolt and nut factory on Eighth Street and Girard Avenue, in 1854, but the venture proved so unprofitable that they sold out their entire establishment in the following year, 1855, to Dennis Daly and Thomas Skelly.

THOMAS SKELLY & CO.

Philadelphia.

Mr. Skelly was a shrewd business man and a thoroughly practical bolt maker, as he had served his time and completely mastered the trade under the employ of the Colemans. In a few months Mr. Skelly purchased the interest of Mr. Daly and continued the business, under the title of The Philadelphia Bolt Works. Mr. Skelly made many improvements in the appliances used, and in the character of his product. He made a specialty of the better grades of bolts and won a very high reputation for his line of fancy bolts, which became extensively popular. Mr. Lawrence Brady, a clever workman who had served as tool "doer" (maker) with the Haydens, was employed as foreman by Mr. Skelly, and proved a valu-

able acquisition. While in the Hayden employ, Mr. Brady had made a notable improvement on the steam or power Oliver, by introducing a device that made the strokes of the hammer variable, so that light or heavy strokes could be given at the will of the operator by the use of the treadle.

Within a year after beginning business Mr. Skelly's establishment was destroyed by fire. Soon after he opened a new factory on Twenty-fourth Street below Callowhill.

Notwithstanding his misfortunes and limited resources Mr. Skelly knew no such word as fail. Progress was his motto, which he employed to the utmost advantage and success crowned his efforts. Mr. Skelly died December 20, 1902.

In later years, Thomas P. Skelly, Jr., "a chip of the old block," became a member of the firm, as did also Larry Brady, the "tool-doer," as he was familiarly called, and both are still industriously following in the footsteps of the successful originator of the enterprise who retired from active business some years before his death.

A. & M. HAYDEN.
Philadelphia.

In the year 1863, A. & M. Hayden, who had also learned the business of the Colemans, established a highly prosperous factory on Twenty-second Street, near Vine. This was during the rebellion, when money-making seemed very easy for most people, and the Haydens were no exception to the rule. Andrew died in 1897. Michael still continues the business at the old stand.

SIMPSON & JACKSON.**Philadelphia.**

In 1864 William Simpson and George Jackson opened a factory at the corner of Twenty-second and Filbert streets, just in the nick of time to meet with the most active competition and a discouraging market. Both partners were reputed to be good business men. They waged a sturdy battle for success and died game early in the eighties. The gossips of the time attributed the failure to Mr. Simpson's political predilections, who was noted as a gifted mixer and extender of the "glad hand" during political excitements. Be this as it may, the firm was forced to suspend.

PHILADELPHIA CARRIAGE BOLT CO.**Philadelphia.**

Notable in the list of failures was a concern known as The Philadelphia Carriage Bolt Co., founded on the co-operative plan, by a number of skilled journeymen bolt and nut makers of the Boltmakers' Union, who, in 1867, built and equipped quite a large factory at the corner of Twenty-fourth and Callowhill streets, Philadelphia.

The projectors were Michael Gallon, Neil F. Dunlevy, Bernard Gallon, Patrick F. McGowan, Michael Brennan, Eugene McCarthy, Samuel Culberston, Anthony Dean and James Hefferon. These names, and their owners, were so conspicuously of Irish origin, that the wags of the neighborhood gratified a far-fetched sense of humor by calling them "Dutchmen," and saying that they must have been born in Germantown.

The new factory was started with flourishing prospects and, indeed, it seemed to be an establishment of rare promise. Ten Olivers and all other then up-to-date machinery comprised



PATRICK KEITH

the outfit and everything was run to the limit, for a short time. Petty jealousies and differences concerning the management soon intervened and accomplished their deadly work. All efforts to harmonize matters failed, and in the end the company was dissolved and the machinery was sold at a heavy loss to purchasers in various sections of the country. This was the first and only co-operative bolt and nut company ever organized by a workingman's union.

MARSHALL & LOUNNEY.

Philadelphia.

In 1866, William Marshall and Edward Louney began manufacturing bolts and nuts, corner of Twenty-fourth and South streets, Philadelphia, employing six Olivers and other machinery. At the end of two years they sold out to James McClelland, who retired from business three years later.

PATRICK KEITH.

The cut herewith represents Mr. Patrick Keith, engaged in making nuts nearly fifty years ago. Mr. Keith was born in Limerick, Ireland, January 9, 1833. Young Keith came to this country in 1852, and immediately commenced to serve an apprenticeship of bolt and nut maker with Coleman Bros., Philadelphia, with whom he served five years and three months, the first three years working for his board and clothes, after which he was given tasks of making 1000 nuts per day at 9 cents per hundred nuts, which was twenty-five per cent. less than the price paid journeymen.

Mr. Keith soon became an expert at forging small nuts and it is said he was the fastest small nut maker on record, making a daily average of 2000 3-16 nuts, bolt size, per day.

In those days the Philadelphia price paid for making forged nuts was 12 cents per hundred nuts, for either 3-16, $\frac{1}{4}$ or 5-16 bolt size, reckoned at 133, 100 and 50 nuts per pound. Connecticut prices paid were invariably 2 cents per hundred nuts higher. These were the ruling prices from 1852 to 1862, when there was an increase of 2 cents per hundred, with an addition of 30 per cent. on a dollar, on the total amount of wages earned, which were known as war prices.

It may be interesting to cite that the cost of labor in making one hundred pounds of 3-16, $\frac{1}{4}$ and 5-16 nuts, respectively, the weight being approximately $6\frac{1}{2}$, $10\frac{1}{2}$ and 21 pounds per 1,000 nuts, would be \$16, \$12 and \$6 per 100 pounds during the period between 1852 and 1862, while by the introduction of hammered cold-pressed nuts, termed the "Yankee Scheme" nuts, because they were first made in Connecticut, and the use of improved forged nut machinery. The price paid in Cleveland for machine-made forged nuts in 1872 were 3-16, \$3.25; $\frac{1}{4}$, \$1.65; 5-16, 80 cents per hundred pounds, and in 1902 it was 3-16, \$1.75; $\frac{1}{4}$, \$1.00; 5-16, 50 cents.

For a number of years young Keith had a fancy for cultivating new and untried fields, and therefore became an itinerant bolt maker. Whenever he heard that a new shop was being started in any section of the country he generally sought and secured employment in the new establishment, which he invariably held until tempted to venture in another field. During his fifty-one years of service in the bolt and nut business Mr. Keith has probably worked in a greater number of factories than any other workman at the trade. In later years, however, Mr. Keith became more settled in his habits, and during the past five years has been in the employ of The Lamson & Sessions Company of Cleveland, where he is still engaged.

During the Rebellion Mr. Keith served in the Union army. He answered the first call for volunteers and enlisted in the

24th Pennsylvania regiment, in 1861. After serving two years in the army, he enlisted as fireman in the navy, where he was assigned to the position of shipsmith and served one year, receiving fireman's pay. In order to secure proper pay for his services, he secured a discharge and immediately re-enlisted as ship's armorer. During the siege of Fort Fisher he was so seriously wounded that he was disabled for the service and was honorably discharged. As a badge of honorable service, Mr. Keith still wears a bullet received in battle which could not be extracted without endangering his life.

THE EARLY BOLT BUSINESS IN PITTSBURGH.

CARTER & REES.

Pittsburgh.

The bustling city of Pittsburgh, Pa., with its vast and increasing iron and steel manufacturing interests, became an early representative of the hot pressed nut industry and soon after proved itself an energetic promoter of the bolt business.

August 26, 1851, Henry Carter and James Rees gave birth to this branch of manufacture, by inventing and patenting a hot-press nut machine. This patent covered the forming and punching of the nut in a box die,— and the specifications and claims embraced all similar inventions during the life of the patent. On November 22, 1853, Messrs. Carter and Rees secured a second patent on their invention, and then associated with them Mr. Joseph P. Haigh, and undertook to manufacture hot pressed nuts with these machines. The enterprise soon failed and the machines and valuable patent were purchased by James Wood & Co., who promptly began the manufacture of hot pressed nuts at their rolling mills on the Monongahela River bank, Borough of Birmingham, near the southern ap-

proach of the Smithfield Street bridge, now the South Side of Pittsburgh, engaging the services of Mr. Carter in the nut department. This was the first company to successfully establish the manufacture of hot pressed nuts as a business in America.

JAMES WOOD & CO.

Pittsburgh.

In 1856 Wood Brothers constructed a bolt heading machine, designed to head carriage bolts from the rod, which was operated to some extent, making carriage bolts with very short squares. A popular prejudice against short squares, however, induced the company to abandon the machine and consign it to the scrap pile as worthless. Nevertheless, the idea upon which it was constructed survived and eventually demonstrated its merit. The nut machine was called "The Carter" nut machine and is still in use, and known as "The Old Carter," which has never been surpassed in quantity and quality of work.

KNAPP, WOOD & CO.

Pittsburgh.

A sister concern, known as Knapp, Wood & Co., doing business at this time, rented a number of Ward carriage bolt heading machines of Russell, Burdsall & Ward, of Portchester, N. Y., and began manufacturing bolts. The enterprise failed, however, as the short or "Stovein" square bolts were unmarketable, and the machines were returned to their owners.

STANDARD NUT CO.

Pittsburgh.

Mr. James Wood died in 1866, at which time it became known as Wood, Matthews & Co., and later on the nut works

were sold to the Standard Nut Co., located in a large brick building on Fifteenth Street, where it did a prosperous business, but in 1887 was absorbed by The Oliver Iron & Steel Co., who were the principal owners of The Standard Nut Co.

JOHN GREBEN.

Pittsburgh.

In 1868 Mr. John Greben, an ingenious mechanic, adopted the principle of the abandoned Wood & Co. bolt heading machine and built a heading machine about half the size of the Lewis Pittsburgh heading machine of the present day, adding certain improvements that rendered it practical. With this and other equipments, including steam power, he opened a small factory on Third Street, Pittsburgh, and began manufacturing stove rods. This was a decided innovation, it being the first time stove rods were made by machinery propelled by steam power west of the Alleghanies. Another novelty introduced by Mr. Greben was a much larger machine designed for making carriage bolts, by up-setting from round iron, hot and oval at the point where the square neck is formed under the head. This necessitated re-heating the blank and placing the largest diameter of the oval to the V or square portion of the heading dies, thus avoiding fins or cold shuts in forming the square, while being headed in one groove of the dies by two strokes of the machine. Mr. Greben's method of preparing the blanks was to inject with considerable force a jet of cold water against the end of the up-setting pin, which served as a gauge and came in contact with the hot bolt blank, in such a manner as to sufficiently chill the extreme end of the blank to prevent its up-setting, thus forcing the hot metal further back into the oval recess in the dies. Very fine full square carriage bolts were produced by this method,—the value of which was recognized, but a lack of means or effort prevented Mr. Greben

from profiting by it as he might have done. Indeed, Mr. Greben's entire business yielded such unsatisfactory returns that he closed it out to Hubley, Adams & Co., to whose works the machinery and effects were transferred in 1867.

HUBLEY, ADAMS & CO.

Pittsburgh.

Messrs. Hubley, Adams & Co. began making bolts and nuts, in Allegheny City, on the river bank near the C. & P. railroad bridge. They devoted a great deal of attention to experimenting with new machinery and devices, and, while they failed to realize anticipated returns for their efforts, they succeeded in profiting other manufacturers in the line, and to these gentlemen the great bolt making industry of the present day owes much. Their square head machine proved especially valuable and to their little old factory on the river bank can be traced many original ideas of forging square heads with two and also four hammers, operated by steam. In 1874 the works of Hubley, Adams & Co. passed into the hands of Frank M. Haslett.

F. M. HASLETT & CO.

Pittsburgh.

F. M. Haslett & Co., a few years later erected a new factory building further down town, near the park, and equipped it with the best and most improved machinery to be had at the time. Mr. Haslett was an energetic and capable man of business, who enjoyed the confidence and respect of all with whom he had dealings. He conducted his establishment with marked success for eleven years and until his death, which occurred in 1885.

Soon after, the factory was purchased by George Head, for his son, Charles B. Head, who conducted the business until 1890, when he formed a co-partnership with C. A. Hotchkiss of Cleveland, Ohio, and John Saur of Allegheny City, Pa.

THE GREENSBURG BOLT & NUT COMPANY.

Greensburg.

This company removed the machinery and effects to Greensburg, Pa., and established The Greensburg Bolt & Nut Co., to which it was said that Mr. Head furnished the machinery, Mr. Saur the financial backing, and Mr. Hotchkiss the business experience.

At the expiration of about two years the company made a total failure and the factory remained closed for a number of years, when it was consumed by fire.

Soon after the failure Mr. Hotchkiss and Mr. Percy Donaldson became interested in the Maryland Bolt & Nut Co. of Baltimore, Md., which also failed in a few years, a circumstance which drove Messrs. Hotchkiss & Donaldson into the pickling business, of which they made a success, thereby proving, perhaps, that they had missed their calling when they embarked in the bolt business, as many others seem to have done.

OLIVER IRON & STEEL COMPANY.

Pittsburgh.

The Oliver Iron & Steel Co. was established April 25, 1863, by Henry W. Oliver, William J. Lewis and John Phillips, who associated themselves together, and started in the manufacture of carriage bolts, machine bolts, plow bolts, nuts, washers and wagon thimble skeins, under the firm name of Lewis, Oliver & Phillips, naming the plant the Excelsior Bolt

& Nut Works. They located at the corner of what is now South Tenth and Muriel streets (then McKee and Neville streets), South Side, in what was then known as the Borough of Birmingham, and which is now the 29th Ward of the city of Pittsburgh. In the early part of the following year they associated with them James B. Oliver and the latter part of the same year David B. Oliver, the latter having previously been a partner in the Kittanning Iron Works of Martin, Oliver & Brickell, and having the general management of their mills.

At the outset of their business they made bolts by foot hammers, known as "Olivers." These made an excellent bolt, but a comparatively small product, which lead Mr. Lewis of the firm to invent and develop a bolt heading machine for forging the heads on different kinds of bolts. This machine, perfected in 1865, was one of the first inventions of the kind. It is still known as the Lewis Bolt Heading Machine, and has been in practical and successful use ever since.

With Mr. David B. Oliver's accession to the firm, rolling mills were established and they began the successful manufacture of iron. In 1868 they erected a large two-story brick building on Eleventh Street, facing their rolling mill, the first arrangement of which was peculiar to say the least. The ground floor was used for forging, and the other machinery, while the second story was used as the finishing department, where oils, acids and chemicals were extensively used for screw threading and cleaning the bolts and nuts. In consequence of this curious arrangement the workmen overhead were constantly annoyed by the smoke and the gases from the forging room, while those beneath were subjected to frequent baths of chemicals and oil that dripped through the floor from the finishing room. The business flourished nevertheless, and grew so rapidly that better arrangements were provided in due time. Mr. Lewis had brought out his bolt forging machine, made up partly on the lines of the old Wood machine, which gained considerable prominence on the market during

the early sixties. In a few years the energetic competition of this company became so strong that many of the eastern manufacturers were induced to move their factories west of the Alleghanies, in order to fight such lusty competition, at shorter range, and to obtain cheaper and better manufacturing facilities. It is undoubtedly the fact that the strenuous competition and progressive business methods of this one great Pittsburgh company largely contributed towards making Cleveland the recognized western center of the bolt and nut business of America. When the exodus from the east began, manufacturers, seeking suitable western locations for their factories, naturally visited the growing city of Cleveland on their tours of inspection, and in a majority of cases that prosperous western mart was wisely chosen, as its advantages for coal, iron and shipping facilities by far outclassed all others, and thence resulted their rapid development of the great industry in the famous Forest City of Lake Erie.

In 1880 Mr. Lewis' interest was bought out and the company reorganized under the style of Oliver Bros. & Phillips, and entered upon the work with renewed energy, enlarging and improving their works and facilities materially and providing them with every appliance calculated to promote utility and economy. In 1887 the business was incorporated as the Oliver Iron & Steel Co. To meet the increasing demands on their resources, they acquired extensive ore properties, the Connellsville Coking Coal Plant, and constructed and operated their own blast furnace and steel plant. The company also have their own natural gas supply in abundance, their pipe line extending through Washington and Green counties to the West Virginia line.

This company was the first to recognize the advantage of using soft steel for carriage bolts, and other bolts, and by adhering to the use of open hearth steel, they claim to produce a bolt equal in quality of material to the Swedish iron bolt, and to sell it at the same price as the common carriage bolt.

They have kept to the front in the development of their business of bolt and rivet making, in addition to which they manufacture a complete line of hardware for use in wagons — such as box strap bolts, bolster plates, hammer straps, neck yokes, attachments, clevises, axle clips, box rods, seat hooks, wagon wrenches, etc. They also manufacture a full line of pole line hardware, such as cross-arm braces, steel insulator pins, pole steps, pole seats, guy rods, pole clamps, all made both galvanized and self-colored. They also manufacture a line of heavy hardware, such as crowbars, picks, mattocks, screw hooks, strap hinges, etc. Many of these specialties were originated and developed and many of them patented by the members of the organization and their associates.

The finishing plants of the company extend from South Tenth to South Sixteenth Street; their factories are three-story buildings, of stone, brick, cement and steel, the floors being cement, and are fireproof. Their mill buildings are, of course, one story, of steel and iron, and are also fireproof. They have been made thus fireproof, as the hazard from fire in a bolt factory is great on account of the combustible nature of the oil used in bolt threading. The science of economy in material, time and labor, is reduced to an absolute system in every detail and department of this great industrial establishment. Their entire machinery is arranged and operated with the perfection of clock-work, and not a wheel turns without a well defined purpose. During the process of manufacture their material passes from one machine to another in heated condition and in such rapid succession as to assure the least possible wastage in heat and to avoid the necessity of rehandling. The iron is cut in required lengths and conveyed to the forges by an endless chain arrangement which is provided with turn-off or switches, so that they can be delivered to the proper forge by turning a switch. For square heads the Burdick is chiefly used, but machines of the Smith type are also used, called the "Clickers" or Hocher machine, which is also built



Very truly
Henry H. Oliver.

larger and used in making track bolts, and the larger sizes of bolts from the rod.

Besides a number of machines and inventions of their own manufacture this great establishment also employs Chapin headers, also a large number of carriage bolt rod machines, about one hundred and fifty in all, with a capacity of over one million bolts per day—all of which are constantly kept busy. Up to 1902 all of their work was done hot. They are now introducing the cold forging process and have installed the latest automatic machines.

The officers of the company are: Henry W. Oliver, chairman; James B. Oliver, president; John C. Oliver, vice-president; Henry B. Lupton, second vice-president; R. Theophilus, treasurer; Charles E. Black, secretary.

HENRY W. OLIVER.

Mr. Henry W. Oliver is the second son of Henry W. Oliver and Margaret Brown, of Donaghmore, Ireland. He was born in the town of Dungannon, in February, 1840. His parents settled in Pittsburgh in 1842, and made that place their home.

Henry was educated in the public schools and Newell's Academy, and started to work when about thirteen years old as messenger boy in the office of the National Telegraph Company in Pittsburgh. About two years later he entered the employment of Clark & Thaw, general forwarding agents, where he remained for some years. In 1859 he became shipping clerk for the iron manufacturing firm of Graff, Bennett & Co. In 1861, at President Lincoln's first call, he enlisted in the 12th Regiment of Pennsylvania Volunteers, serving until the end of his term of enlistment of three months. He also volunteered at the time of Lee's invasion in 1863 as an emergency volunteer. The first of January, 1863, in partner-

ship with Wm. J. Lewis and John Phillips, he organized the firm of Lewis, Oliver & Phillips, and began to manufacture bolts and nuts on a small scale. In 1866 Mr. Oliver's two brothers were admitted into the firm, which continued in business until 1880, when the partners organized the firm of Oliver Bros. & Phillips. In the meantime the business of the firm had been enlarged to an enormous extent, until they were among the largest manufacturers of bar iron and iron specialties in the United States. In 1887 the works were incorporated under the name of Oliver Iron & Steel Co., which is still carried on, Mr. Oliver acting as chairman of the board of directors until he died.

In the meantime he became identified with other industrial and railroad affairs in Pittsburgh, notably a heavy stockholder in the Pittsburgh & Lake Erie R. R. Co., which was the first railroad to actively compete with the Pennsylvania Railroad Company for Pittsburgh business and tonnage. Mr. Oliver was one of the original projectors of this road, and one of the largest stockholders, and after it was started he added largely to his holdings. It becoming evident that the road would probably fall under the control of either the Pennsylvania or the Baltimore & Ohio (the only trunk lines then entering Pittsburgh), in 1883 and 1884 he sold out to the Vanderbilt interests, thereby giving them the control of the road and introducing an additional trunk line into Pittsburgh. He afterwards became largely interested in the Pittsburgh & Western Railway Company, and from 1889 to 1894 he was its president.

Mr. Oliver was also president of the Oliver & Snyder Steel Company of Pittsburgh.

Mr. Oliver justly earned the eminence accorded him as one of the most prominent and successful manufacturers of the country. He was pre-eminently the architect of his own fortune, and to his executive ability, earnest application to his business affairs and the fair and upright spirit that char-

acterized all of his dealings, the uniform success of his many undertakings is due.

Mr. Oliver died at his home in Pittsburgh, February 8, 1904.

MATHEW LANZ & SONS.
Pittsburgh.

The firm of Mathew Lanz & Sons of Pittsburgh, Pa., was organized in 1865, since which they have conducted a highly successful business in the manufacture of bolts, nuts, rivets, washers, spikes, hinges, etc. In reply to a letter of inquiry concerning the history of their company Lanz & Sons state that their bolt and nut business "never amounted to much." The fact remains, however, that the company has conducted a very prosperous business for thirty-eight years.

J. H. STERNBERGH & SONS.
Reading.

In October, 1865, Mr. J. H. Sternbergh removed from Saratoga Springs, N. Y., to Reading, Pa., for the purpose of engaging in the manufacture of hot pressed nuts. Prior to this time he had been for over fifteen years a clerk in the general office of the Saratoga & Whitehall R. R. at Saratoga, the duties of which position were congenial and pleasant, but he determined to leave this position, which promised nothing more than a fair salary. Accordingly, he resigned and spent the next four or five months endeavoring to find an occupation that would suit his tastes without overtaxing his impaired eyesight, and in which, if he were successful, he would hope to secure the benefit of any experience or ability he might develop, for his own advantage rather than for that of others.

Accordingly, after investigating the prospects of success in

the manufacture of carpet tacks and one or two other branches of the manufacturing business, he finally became interested in a machine that had been recently invented and patented by Mr. O. C. Burdick and manufactured in New Haven, Conn., by the Lindsay Fire Arms Co. He purchased two of these machines — one to make nuts for $\frac{5}{8}$ inch bolts and the other for 1 inch bolts, together with the right to use them in the territory of Eastern Pennsylvania and the State of Delaware. These machines were recommended by the builders as the best adapted for economy and efficiency of any machine in the country for the purpose. In proof of their excellence, leaden nuts were shown which had been made on the machines, and with the assurance that the machines were adapted to make iron nuts with equal facility. Mr. Sternbergh had no friends or acquaintances in Pennsylvania nor Delaware; but after a visit to Scranton, Reading, Philadelphia and Wilmington, for the purpose of investigating the facilities of each of these places, he decided to locate in Reading, to which place he removed his machines, rented power and built a small shop, where he began the experiment of making hot pressed nuts. He knew nothing of the business, however; had never worked a day at any mechanical trade; had not even a theoretical knowledge of mechanics and no known fitness for entering upon this or any other branch of the iron business. As a natural consequence he soon began to realize that his undertaking was unusually venturesome, if not hazardous. His sole capital in money consisted of a little less than \$10,000, which he had saved during his fifteen years in the railroad service by great personal economy and persistence in laying aside every month a part of his wages.

Of this sum he paid a large part for the exclusive right to the territory mentioned and the two machines, and adding to this the cost of the new shop, tools and fixtures, labor, etc., at the end of the first two years he found himself without funds and largely in debt, with no apparent prospect of recovery.

The nut machines he had brought to Reading, while well enough adapted to make beautiful lead nuts, were entirely unsuited for the manufacture of iron nuts, hence disappointment, discouragement and debt resulted.

At this early period of the industry there were but three or four concerns in the whole country making hot pressed nuts by machinery — Wood, Mathews & Co. of Pittsburgh, Pa., and Fuller, Lord & Co. of Boonton, N. J., being the more prominent makers at that time, and each employing their own special machinery for the purpose. There was no such machinery to be had in the open market, no skilled workmen to be employed familiar with the industry and not a scrap of literature accessible on the subject. Hence beginners were obliged to build from the foundation up and to rely entirely upon their own resources. There was no standard list of the sizes and proportions of nuts, nor any uniform list of prices for the various sizes, each of the three or four makers having their own special price lists, and evidently there had been no interchange of views among them for the purpose of the adoption of a common list. The sizes of nuts made by these firms were mainly the suggestion of the sizes made by blacksmiths in former years and, of course, were of a clumsy character, with the short diameter, usually twice the diameter of the bolt rod, and many deviations from this proportion. It was the custom among rolling mills in those days to roll round iron 1-32d and sometimes even 1-16th over the neat sizes called for; seldom was iron to be found rolled correctly to the exact size; consequently the holes in the nuts had to be made suitable for not only the neat size, but for the various extra sizes to which iron might be rolled. Consequently for every size of nut, the hole was made not only for the neat size iron, but for iron 1-32nd full and over up to 1-16th full. These sizes were called the Franklin Institute size, the "P" or Paterson size and the Manufacturers' size. At the present time nearly all

rods are rolled to exact dimensions, consequently only one standard size of hole is required for each size of rod.

In view of all these embarrassments Mr. Sternbergh found himself in a serious dilemma. But necessity has often proved the mother of invention, and Mr. Sternbergh found a fresh illustration of this maxim in his own case. By the end of the second year he had invented and patented an entirely new hot pressed nut machine, now generally used throughout this country and known by his name, and greatly to his delight he found the first machine he built was a success. With this machine he was able to make $\frac{5}{8}$ -inch nuts and smaller sizes, square and hexagon, very satisfactorily, and later developed and improved the machine, building three different sizes capable of making all sizes from $\frac{1}{4}$ -inch nut up to nuts for a 2-inch diameter bolt, and later still a much larger machine capable of making nuts for a 3-inch diameter bolt.

At that period of the industry the box die in which the hot nuts were pressed, shaped and punched, was made of English crucible cast steel, the several parts being accurately planed to the required dimensions and hardened so as to make the cutting faces and interior surfaces of the box die as durable as possible. The hot nuts, however, soon took the temper out of this steel die box and consequently the soft steel was rapidly cut away in the process of cutting off the nut blank, pressing it into shape within the box die and piercing it, so that owing to the increasing wear of the box die it was found impossible to maintain a uniform size of nuts produced. The frequent renewal of this box die was very expensive and greatly diminished the production of nuts. Here was a new dilemma. After giving careful thought to the subject, Mr. Sternbergh found the necessity of using a material for the box die having a natural hardness that would be capable of resisting the action

of the hot metal without unreasonable wear. Accordingly he conceived the idea of using charcoal pig iron for making chilled iron dies with surfaces so hard that the hot metal would have little or no tendency to wear or cut away. But here a new difficulty was encountered, in the fact that these chilled dies could not be filed nor dressed up on a planing machine to suit to the sizes required. Satisfied, however, that the chilled iron die was what he wanted, and for the purpose of overcoming the difficulty of readily planing and fitting them to the sizes required, he invented and patented a surface grinding machine, using an emery wheel mounted over the table of an iron planer in place of the usual cutting tool, which wheel was made adjustable in vertical and horizontal directions. The wheel was run at high speed and the chilled dies were fastened to the table of the planer underneath the wheel, and by the adjustments mentioned, he was able to grind with great accuracy and rapidity the chilled surfaces for both the square and hexagon die boxes, and he found these dies to be most admirably adapted for the purpose. With the steel dies above mentioned, he was able to make only a few hundred pounds at a time before the dies would have to be removed from the machine and re-dressed at great expense, but with the chilled iron dies he was able to make from 50 to 100 tons of nuts with one set of dies without re-dressing.

These two inventions — the nut machine and the surface grinding machine — enabled Mr. Sternbergh to manufacture hot pressed nuts with greatest economy and to eclipse his competitors. As a result he enlarged his capacity of production, sold his products in all parts of the country, rapidly recovered his losses, and built new and enlarged works at the corner of Third and Buttonwood streets, Reading. From that time forward he had numerous applications from parties willing and

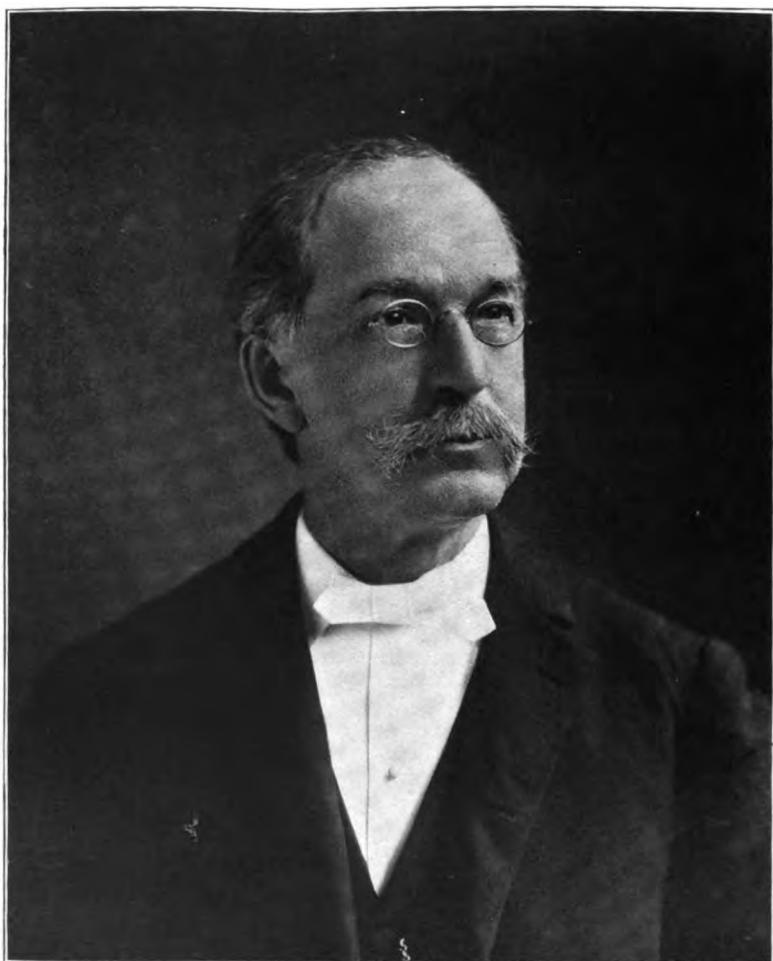
anxious to join him in his new venture; but refusing all these, he continued to operate his works alone, until his sons arrived at their majority, when they were taken into partnership.

In the meantime, Mr. Sternbergh added the manufacture of machine bolts, lag screws, railway track bolts and other goods and his establishment grew by frequent additions until the first of September, 1899, when he employed about 1500 men and had obtained a reputation second to none for the excellence of his products. On the date above mentioned his establishment was consolidated with the Pennsylvania Bolt & Nut Co., Lebanon, Pa.; the National Bolt, Nut & Rivet Works, North Reading, Pa.; the Lebanon Iron Co. of Lebanon, Pa., and the East Lebanon Iron Co. of Lebanon, Pa., forming the American Iron & Steel Mfg. Co., employing at the present time about 4,000 men, and shipping their products to all parts of the country and abroad.

In order to retain his hold of the trade which he had established throughout the West and the Northwest Mr. Sternbergh built and equipped in 1887 the Kansas City Bolt & Nut Works at Kansas City, Mo., which has been constantly operated under his management until the present time, and which now employs about 400 men in the manufacture of not only nuts, but bolts of every variety, railway spikes and track fastenings and merchant bar iron and other goods.

Prior to the manufacture of hot pressed nuts in this country, cold punched nuts were made by several establishments, and by far the great majority of all nuts made were of this class, but now owing to the greater facility and economy with which hot pressed nuts are made, it is probable that at least three-fourths of all the nuts made in the country are of the hot pressed variety.

It should be added that Mr. Sternbergh was the first to perfect a machine that successfully cold-rolled threads on bolts.



J. H. Stenhouse

J. H. STERNBERGH.

Mr. James Hervey Sternbergh has been identified with the bolt and nut industry for over forty years, during which time he has organized and piloted to success such a number of extensive manufacturing establishments that his name is conspicuously associated with this important branch of business in every section of the country.

Mr. Sternbergh was born near Rochester, N. Y., in May, 1834. He acquired the rudiments of a commercial education while employed as a clerk in the general office of the Saratoga and Whitehall railroad at Saratoga, N. Y., serving from 1850 until 1865, when failing sight, due to overtaxing his eyes, compelled him to seek some other occupation.

With a view to embarking in the manufacturing business, he canvassed several branches and finally decided to invest in nut machines that had been recently invented and patented by O. C. Burdick. Purchasing two of these, together with the rights of Eastern Pennsylvania and Delaware, he established a factory in Reading, Pa., where his machines proved so impractical that at the end of two years of costly experimenting, he had exhausted his entire capital of \$10,000, and accumulated a considerable indebtedness. And though not a trained mechanic, Mr. Sternbergh had a natural mechanical genius, which he employed to such advantage during these two years of adversity that he succeeded in inventing an exceedingly valuable hot pressed nut machine, since known as the "Sternbergh machine," which he patented, and which opened a new avenue to fortune. Mr. Sternbergh followed this with a number of other valuable devices, notably, the introduction of cast chilled dies for forming nuts and an ingeniously constructed surface grinder for finishing the dies.

Utilizing the profits on these excellent devices and employing them advantageously, Mr. Sternbergh soon found himself

on the road to prosperity. Indeed, his many subsequent business ventures invariably proved successful and prosperity smiled on his every undertaking.

In another chapter of this work is given a detailed account of Mr. Sternbergh's many business enterprises. As an organizer of large and successful industrial and commercial enterprises, few men have equaled Mr. Sternbergh. A remarkable capacity for labor and application, a natural mechanical genius, a keen business sagacity and foresight were qualities that distinguished his character and contributed to his marked success as a manager and an organizer of the many enterprises with which he has been connected.

Mr. Sternbergh's latest and most important achievement was that of organizing the American Iron and Steel Manufacturing Company, of which he is now president.

W. DAVIS & N. F. DUNLEVY.
Frankfort.

In 1868 William Davis began making fancy bolts, chiefly step and shaft bolts, in Frankfort, near Philadelphia. He used four Olivers which with his finishing machine and fire blowers, were run by a small engine. He suspended business in 1874. About a year later, Neil F. Dunlevy reopened the factory and ran it until 1880, at which time he followed in the footsteps of his disappointed predecessor and closed the factory sine die.

TOWNSEND, WILSON & HUBBARD.
Philadelphia.

In 1868 Mr. William Hubbard, an able mechanic, projected and organized the firm of Townsend, Wilson & Hub-

bard, in Philadelphia, Pa. Both Mr. Townsend and Mr. Hubbard were men of experience in the bolt and nut business, the former having been connected with the factory of Hoopes & Townsend, and the latter with that of E. & P. Coleman.

The new firm erected a fine brick factory building, on the Schuylkill River, at the foot of Cherry Street, which they equipped with the best machinery available at the time, for manufacturing carriage bolts from square iron, using rattlers for rounding and machines for heading.

Three years later, in 1876, Mr. Hubbard visited the factories of Cleveland, and acquainted himself with the more modern and practical methods employed in that city. Soon after returning Mr. Hubbard made an entire change in his system of forging, by introducing methods similar to those employed by the Cleveland Norway Bolt Co., which consisted of upsetting cold and heading hot, and making bolts from round, instead of square iron. The longer bolts, ranging from $2\frac{1}{2}$ inches, upwards, were headed by this process, and the shorter lengths were headed with upright hammers, or drops, after being upset by the Philadelphia system, of short, stubbed upsets. This company constructed a furnace and moulds for casting semi-steel dies or bores, which they used successfully in dropheading. The capacity of the factory was about 60,000 bolts per day. After a few years of moderate success, the business of the company began to decline. It continued in business, however, until 1887, when the factory was closed and the machinery was sold to western companies, the large upsetter being purchased by the Columbus Bolt Works, Columbus.

Mr. Hubbard, the leading spirit of the enterprise, lost his entire fortune when the suspension occurred, and, broken in health and energy, he died a few months later, adding one more to the list of martyrs to misapplied effort of whom the history of the bolt and nut industry presents so many examples.

DANIEL CALAHAN.**Philadelphia.**

In 1874 Daniel Calahan established a small but excellently equipped factory for the manufacture of fancy bolts on Race Street, Philadelphia. A few months after entering upon what promised to prove an extremely prosperous business venture, Mr. Calahan fell heir to a princely fortune, a circumstance that induced him to promptly abandon the manufacturing enterprise, without attempting to prove whether it was destined to be recorded in the list of successes or failures, and depriving this history of the privilege of giving it a classification.

CHARLES & McMURTY.**Pittsburgh.**

In 1874, a patent right of brilliant promises, but of disappointing fulfillment, was secured by Messrs. Charles & McMurtys, who established a nut factory on Penn Street, near Eleventh Street, Pittsburgh, Pa., during the same year. The following points were embraced in the patent:

“ William Charles, Chartiers Township, Allegheny County, Pa., and M. McKain, Pittsburgh, Pa., filed August 31, 1874, an application for a patent on a nut machine which was granted October 6, 1874. No. 155,638. This invention and machine was designed for saving scrap and punchings, especially in making hexagon nuts. The piercers or punches were originally made with their points in form of a pair of blunt engine lathe centers. The nut was made by cutting off the stock and confining it in a box between the crowner and the cutting-off square, or hexagon punch, as the case might be. The two piercers, or round punches, were then forced together, their points nearly meeting in the center of the nut, thus forcing the surplus stock, that would otherwise come out

in the punchings, or off the corners, into the body of the nut, when the one punch withdrew and the other passed through, carrying with it a light, thin shell or shuck.

This process made, probably, the handsomest and best appearing hot pressed nuts in the country. The resistance was so great, however, that the punches would not endure the strain for any considerable length of time, and the expense for tools was so great that the machine could not be profitably run. It was therefore abandoned after a few years of costly experimenting and the process was never successfully revived. Eventually the style was changed to John Charles & Co., and is now known as the Graham Nut Co., and located in Allegheny.

LANCASTER BOLT COMPANY.

Lancaster.

In 1874 the multiplying industries of the thriving little city of Lancaster, Pa., were augmented by the advent of a new enterprise, styled the Lancaster Bolt Co. Mr. W. C. Buchanan was the projector, treasurer, principal owner and manager of the factory, which began operations by heading bolts from square rods and rounding the stems or shanks by using compressed air to operate pneumatic hammers. After being thoroughly tested, the process proved so unsatisfactory that the complete Philadelphia system was substituted and Olivers were employed.

In 1884 the business was absorbed by the Columbus Bolt Works, with which Mr. Buchanan became connected.

PENNSYLVANIA BOLT AND NUT COMPANY.**Lebanon.**

This company was organized July, 1881, by the following residents of Reading, Pa.: James Lord, formerly chief clerk in the office of J. H. Sternbergh & Son; Henry S. Eckert, George B. Eckert and Aaron Wilhelm. The office and works were located in Lebanon, Pa., where quite an extensive business was soon established. The company operated a rolling mill, manufacturing merchantable iron from scrap to be converted into bolts, nuts and car forgings of every description. The machinery used in bolt forging was largely of the Burdick pattern and the nut machines were of various styles of construction. In the finishing department, known in the Pennsylvania Dutch vernacular as "the smutsy," could be found an assortment of machines, ranging from the Martin Barnes thread-cutting lathe to Durrell's upright revolving nut tapper. While the equipment of the factory was faulty in certain particulars, its economical methods of converting scrap and refuse iron into manufactured goods, enabled the company to conduct a very large and prosperous business, which it continued until September 1, 1899, when it was sold, bodily, to The American Iron & Steel Manufacturing Company.

NEELY NUT & BOLT COMPANY.**Pittsburgh.**

The present "Neely Nut & Bolt Co." of Pittsburgh, Pa., was organized in January, 1882, under the name of Marland & Neely, by Alfred Marland and Thomas Neely, who, up to that time had been employed as superintendents by the Oliver Iron & Steel Co. In July, 1882, the firm was changed to Marland, Neely & Co., Limited. Alfred Marland was made chairman, and Thomas Neely, secretary and treasurer. In 1885 Mr. Marland retired, and Edwin Bindley became

chairman. The limited partnership agreement expired in 1902, at which time the Neely Nut & Bolt Co. was organized, with the following officers: Edwin Bindley, president; Thomas Neely, secretary and treasurer. Directors: Edwin Bindley, John Bindley, and Thomas Neely, the latter being managing director.

This company purchased the plant and good will of the old firm and are continuing the business practically under the same ownership and management. The company manufactures a full line of staple bolts and nuts, and makes a specialty of heavy bolts, rods, etc., for bridge and structural purposes.

NATIONAL BOLT, NUT & RIVET WORKS. **Reading.**

This company was organized in 1890, with the following officers: Charles W. Wilhelm, president; Walter S. Davis, treasurer, and H. J. Hayden, general manager. Their fairly equipped factory was located at Riverside, North Reading, and its product was a general variety of staple bolts, nuts and rivets. After continuing in business until September 1, 1899, it was absorbed by the American Iron & Steel Company.

PITTSBURGH SCREW & BOLT COMPANY. **Pittsburgh.**

The Pittsburgh Screw & Bolt Co., organized in 1896, occupies one of the large buildings vacated by The Westinghouse Company, 23rd and Liberty Streets. About twenty heading machines, chiefly of the Burdick pattern, manufactured in Pawtucket, R. I., are employed, as are also several Acmes, made in Cleveland, Ohio. Besides making a full line of square heads and various sizes of special bolts up to $1\frac{1}{4}$ in diameter, this company is extensively engaged in the

manufacture of automatically made machine screws of various sizes and styles, and also cold punched nuts and washers, finished, case hardened and plain, hot pressed nuts and rivets. The establishment is apparently doing a highly prosperous business. H. H. Westinghouse, president; Thos. W. Smith, first vice-president and treasurer; H. E. Bidwell, second vice-president; C. G. Costin, secretary.

FORT PITT FORGE & IRON COMPANY.
Pittsburgh.

The Fort Pitt Forge & Iron Co. also occupy one of the Westinghouse buildings, 25th and Liberty Streets. This company commenced business in 1900. Acme heading machines are employed, principally, in the manufacture of large bolts and rivets—the former ranging from 1 inch to $2\frac{1}{2}$ inches diameter, and the latter from $\frac{7}{8}$ to $1\frac{5}{8}$ inch diameter. The company is said to be doing a paying business under the able management of Thos. W. Smith, head of the firm, and who practically manages this and the Pittsburgh Screw and Bolt Co.

AMERICAN IRON & STEEL MANUFACTURING CO.
Lebanon.

On September 1, 1899, this company purchased the works and business of the Pennsylvania Bolt and Nut Company, the Lebanon Iron Company and the East Lebanon Iron Company, all of Lebanon, Pa., also the works and business of J. H. Sternbergh & Son and of the National Bolt, Nut & Rivet Company, both of Reading, Pa. These several plants were among the largest and best appointed of their kind in the United States. By the consolidation of these several interests, the American Iron & Steel Manufacturing Company became the largest manufacturers of bolts, nuts, rivets and

kindred articles on the globe. The company employs 4,000 hands, and in the finished bar iron department alone produces an annual output of about 150,000 tons. In addition to this, the several plants make large quantities of every kind of car forgings, steam railroad and traction forgings, shipyard supplies, ship chandlery supplies, railroad spikes, turnbuckles, washers, bolts, nuts, rivets, etc.

The company's immense equipment embraces the latest and best of everything that the market affords, and is always kept up to date. The product of the various plants is maintained at the highest standard of excellence, both in quality of material and workmanship.

The officers are J. H. Sternbergh, Reading, President; H. M. Sternbergh, Reading, vice-president; H. M. M. Richards, Lebanon, treasurer; C. M. Hallman, Lebanon, secretary; James Lord, Lebanon, manager.

THE MILTON MANUFACTURING COMPANY.

Milton.

The Milton Manufacturing Company commenced business in 1887. Primarily they made bolts, but early in the nineties added the manufacture of nuts, suspending the bolt business, which was finally abandoned and the machinery set out in the yard. Hot pressed and cold punched nuts and washers and refined bar iron are their specialties, for which they have established a satisfactory and improving market.

The officers of the company are: George S. Shimer, president; Elmer S. Shimer, vice-president and treasurer; William A. Heinen, assistant treasurer; Thomas Miles, superintendent.

GARLAND NUT & RIVET COMPANY.**Pittsburgh.**

The Garland Nut & Rivet Company is an outgrowth of The Garland Nut Co., of Pittsburgh, Pa. In 1903 the Garland people entered into an arrangement with Geo. Dunham & Sons of Unionville, Conn., by which the Garland Nut & Rivet Company acquired the right to use Dunham's patents and machinery in the manufacture of the various styles and finish of cold punched nuts.

The company have established offices in the Frick Building, Pittsburgh, and erected a new plant, in West Pittsburgh, twelve miles east of New Castle, Pa., where they are building up a thriving little village and are doing a satisfactory business.

JONES & LAUGHLIN STEEL COMPANY.**Pittsburgh.**

Incidentally this company manufactures bolts and nuts in connection with their immense steel and iron works on Carson Street, Pittsburgh, Pa. The Jones & Laughlin Steel Co. ranks among the largest and oldest manufacturers on the South Side. They are rated at \$10,000,000.

THE GRAHAM NUT COMPANY.**Allegheny.**

The Graham Nut Co., successor to John Charles & Co., was established in 1874. Their works are located in Allegheny City, Pa., and they manufacture nuts, bolts, washers and rivets. They do a prosperous business. The company is officered by Albert Graham, president; Harry C. Graham, treasurer; Charles J. Graham, secretary.

HUBBARD MANUFACTURING COMPANY.**Pittsburgh.**

The Hubbard Manufacturing Company, managed by John W. Hubbard, makes a specialty of manufacturing shovels, mauls, pinch-bars, etc. In 1901 a bolt, nut and washer department was added to the factory, which is located on Sixty-second Street, Pittsburgh, Pa.

THE PITTSBURGH FORGE & IRON COMPANY.**Pittsburgh.**

The Pittsburgh Forge & Iron Company, manufacturers of bolts and nuts, in connection with their iron business. Their factory is located on Wood's Run, near Allegheny City, Pa., and their office is in Pittsburgh.

ALLEGHENY FORGE & IRON COMPANY.**Allegheny.**

The Allegheny Forge & Iron Company, manufacturers of bolts, nuts and rivets, is located on Pine Street, Allegheny City, Pa.

NEW CASTLE FORGE & BOLT COMPANY.**New Castle.**

This enterprising company was organized January 1, 1902, with a capitalization of \$75,000, which one year later was increased to \$300,000, paid up capital. They manufacture bolts, nuts, rivets, washers, chains, car and drop forgings, and heavy hardware. Large additions are being made to their

already extensive plant, which is under the able management of Frank Ryman, president; C. J. Kirk, treasurer; J. Norman Martin, secretary; James F. Donahue, manager of sales.

THE SCRANTON BOLT WORKS.

Scranton.

The Scranton Bolt Works, of Scranton, Pa., is a new firm that is exclusively engaged in the manufacture of bolts and nuts.

SECTION III.

OHIO.

SAMUEL COLEMAN.

Cincinnati.

In 1856 Mr. Samuel Coleman, one of the Coleman Brothers, of Philadelphia, whom he had served as bookkeeper for a number of years (acquiring a thorough knowledge of the bolt and nut business, in the meantime), established a bolt and nut factory in Cincinnati. He employed a small number of expert bolt and nut makers from Philadelphia. A few years later, Mr. Coleman removed his works across the Ohio River to Covington, Ky., where he did a fairly prosperous business until 1864, when he sold out to Simon Smith, who built a ten-inch rolling mill in connection with the plant. The rolling mill was sold afterwards to The Lake Erie Iron Company of Cleveland. The bolt and nut works, operated only at intervals, was finally sold to The Anderson Bolt & Iron Company of Anderson, Ind. In transmission, however, the ill-starred machinery met with another calamity in a railroad wreck, by which it was damaged beyond restoration.

L. M. DAYTON.

Cincinnati.

In 1874, Col. James Simpson, seeming to have recovered from his sad experience in the bolt and nut business at Greenfield, O., formed a co-partnership with Edward Reamer, for-

merly a traveling salesman for The Plant Manufacturing Company of Plantsville, Conn. They equipped a small factory on Third Street and began making carriage bolts from square iron, doing the rounding with small steam hammers, invented by Robert Smith of Plantsville, who was employed as superintendent of the factory. The process proved entirely impractical and the works were sold out in 1877 to Col. L. M. Dayton, when it soon became recognized as the leading establishment of the kind in Cincinnati during its day. Col. Dayton was as popular as his factory was prosperous. Although a shrewd, careful and energetic business man, he was whole-souled, jovial and a hale fellow, well met in all companies. Yet he could be quite brusque at times, and never more so than when he suspected that some meddlesome fellow was nosing around his factory for the purpose of getting "pointers" to give away to other manufacturers in his line. As a matter of fact, Dayton's factory was not strictly up to date, even for the early days of its existence. Its arrangement was faulty in many respects, its equipment was not the best that could be found, and here and there implements were utilized that gave it an air of shiftlessness. Nevertheless, it turned out marketable product, and there were certain quirks about it that the colonel regarded as sacred and to be guarded against prying eyes; hence a conspicuous sign above the factory door bore the inscription, "No admittance, call at the office."

Among the quaintest things improvised by the colonel were a number of discarded mowing machine seats that looked as though they had been gathered from the scrap iron pile. These were attached to a number of machines to provide seats for the operators, and the combination was exceedingly unique, not to say grotesque.

One day an expert bolt maker visited the Dayton works on a tour of inspection, and ignoring the "keep-out" sign, walked into the shop, where his attention was at once absorbed by the

strange appearance of the hybrid machines. He was gazing, wide-eyed, at one of the curious affairs and wondering if the operator was mowing grass or making bolts, when he was discovered by the colonel. "What do you want in here?" shouted the colonel.

The stranger explained that he was an experienced bolt and nut maker from Cleveland, and that he was seeking employment.

"Get out!" shouted the colonel. "We don't want any hands. You sneaked in here to steal my ideas and take them to Cleveland."

"Very likely," said the stranger, pointing to one of the mower seats, "but if I were to take that idea to Cleveland they would drown me in the lake."

Col. Dayton prospered until his death, which occurred in May, 1901. In May, 1896, the works were purchased by the Upson Nut Company and Lake Erie Iron Company, Cleveland, and John Charles & Co. and Marland, Neely & Co., Pittsburgh, and the larger portion of the bolt machinery, mower seats included, was moved to Cleveland.

CENTRAL BOLT WORKS.

Cincinnati.

The Central Bolt Works of Cincinnati was organized with a capital of \$35,000 in 1885. Its chief product was the heavier grades of bolts and forgings. It seems to have had tolerable success for a few years, but finally disappeared and no one seems to know why.

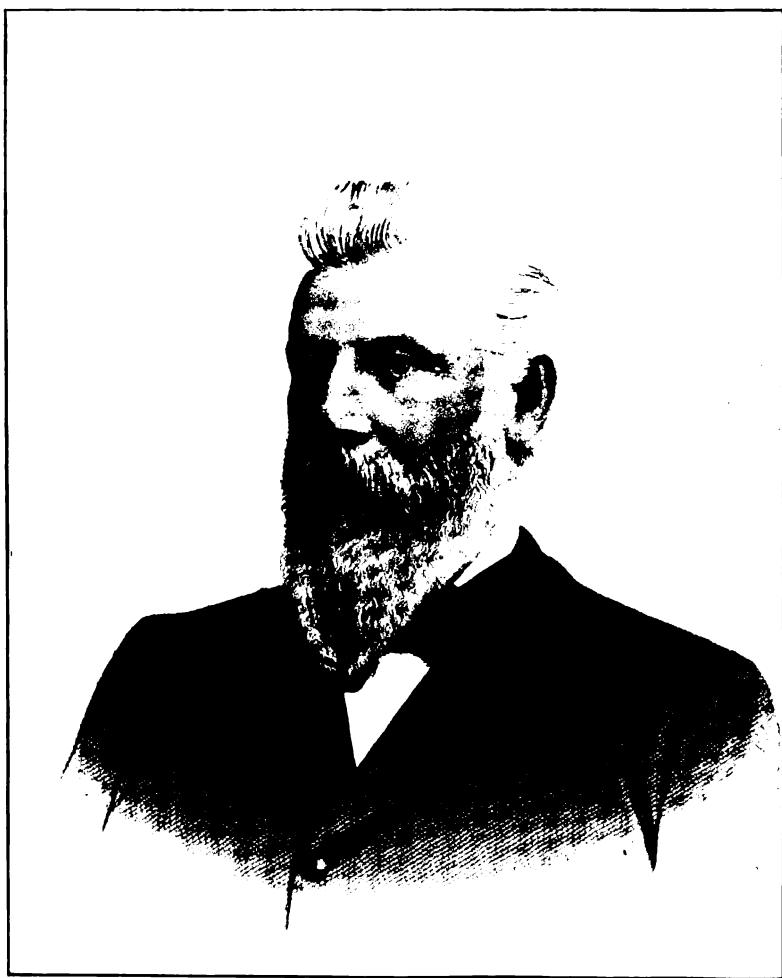
THOMAS HENRY LAMSON.

Mr. Thomas Henry Lamson first beheld the light of day amid the picturesque old Berkshire Hills of Massachusetts, on July 16, 1827. His native village was Sheffield, and he enjoyed the proud distinction of having been born and reared in an old-fashioned log house of the most rugged type, enriched by the coziness of its broad and cheerful fireplace and its quaint and primitive furnishings. During his entire life, Mr. Lamson cherished a tender affection for the old home-stead, the pretty little village of his nativity and the sublime scenery of the grand old New England hills. In later years he was always at his best when in a reminiscent mood. At such times it was his greatest delight to banish all reckoning of the lapse of years, and quietly relate "back-log" stories of the thrilling and other adventures of his boyhood days. He became poetically eloquent on such occasions and painted mental pictures of the Berkshire Hills and dales and of his old home surroundings with the skill of a finished artist.

Mr. Lamson entered active business life at an early age, as an employe of H. A. Miller, a manufacturer of metal and wood clock dials and other commodities. Here he applied himself so industriously to the mechanical arts that he became qualified to accept and ably discharge the duties of general foreman of the nut and bolt works of Mr. J. B. Savage at Southington, which position he held with credit until tempted to enter broader fields of industry.

Mr. Lamson's first business venture, in which he was associated with a number of other bright young mechanics and business men, was the founding of the Miller Manufacturing Co. at Miller's Station, Conn., an ambitious enterprise, the history of whose rise and fall is fully given in this work.

Mr. Lamson's next business undertaking was in Mt. Carmel, Conn., where, in company with Mr. Walter W. Woodruff, he embarked in the manufacture of pinched-neck carriage



T. H. Lamson

bolts. This business was continued with but moderate success until 1866, when it was sold to Messrs. Peck, Stow & Wilcox of Southington.

Mr. Lamson now resumed his former position as foreman for J. B. Savage, which he held until 1867, when he organized The Mt. Carmel Bolt Co. At the expiration of a few months this company was bought out by Messrs. S. W. Sessions, T. H. and I. P. Lamson, and the firm of The Lamson & Sessions Company was organized. The new company continued the business until 1869, when they removed to Cleveland.

Mr. Lamson was the originator of this successful enterprise. He was a stockholder and an officer of the company at the time of his death, which occurred at his home on Jennings Avenue, Cleveland, August 17, 1882.

Mr. Lamson was a man of the stanch old Yankee type. He met his repeated reverses philosophically — never yielding to discouragements nor repining at the buffets of fortune. In the end, his skill, perseverance and heroic determination to succeed, met a generous reward and justly earned for him an honest independence and a goodly fortune.

BOURNE & KNOWLES MANUFACTURING CO.
Cleveland.

The business of the Bourne & Knowles Manufacturing Company was originated in South Boston, Mass., by Sherman, Damon & Co. in 1858, at which time Mr. Damon began making cold punched nuts and washers, in small quantities, with an old-fashioned English lever press, known as the "grasshopper." It was constructed after the manner of rolling mill shears, the front end of the lever carrying a slide and punch, operated by a fly wheel, gear and pinion, crank shaft and connecting rod. The rod connected the crank shaft to the rear end of the lever and worked from under-

neath. The wheel shaft and gears were necessarily placed in a pit so that the tools could be conveniently reached by the operator of the press. As a whole, the machine had the appearance of being designed to make tremendous jumps. Its motion was grotesque and somewhat resembled that of a cripple descending a steep incline.

In 1864 the company removed to Cleveland, and located their factory at the corner of Main and Elm Streets. In 1866 the firm was changed to Bourne, Damon & Knowles. In 1871 it was changed to Bourne & Knowles, and in 1881 the company was incorporated as The Bourne & Knowles Manufacturing Company, with a paid-up capital stock of \$75,000.

This was the pioneer company to manufacture cold punched nuts and washers in Ohio, for which they rapidly created a demand throughout the western markets.

Corresponding to a steadily increasing demand on their resources the facilities of the company have been largely increased from time to time, and they now occupy a two-story main building 45 x 150 feet and a number of smaller buildings assigned to different branches of work. These are provided throughout with the most modern machinery, so arranged as to secure the best possible results. Their immense trade extends to every section of the country, but is especially large in the Western States and Territories.

The officers of the company are Eben H. Bourne, president; Sylvanus Bourne, secretary, and J. E. Norris, treasurer.

It has been mentioned that this company was the first to introduce the manufacture and sale of nuts and washers in the West. Subsequently they began the manufacture of bridge and other large rivets, which they produce in immense quantities.

Messrs. Bourne are natives of New England. President E. H. Bourne was born in Wareham, Mass., October 22, 1840. For a number of years previous to his removal to Cleveland,

in 1866, he was assistant treasurer of The Old Colony Railroad Co. Besides his manufacturing business, in Cleveland, Mr. Bourne served as cashier of The Union National Bank until 1904, when he succeeded the late Senator M. A. Hanna as president.

Secretary Sylvanus Bourne, also a native of Wareham, succeeded his brother as assistant treasurer of the Old Colony Railroad and held the position until he came to Cleveland to join his brother in the manufacturing business.

BRADLEY & LEWIS, ET AL. *Cleveland.*

The history of this company is featured not unlike that of a number of other ventures in the bolt and nut business. It was founded by Messrs. Franklin Bradley and Averisto L. Lewis, of Southington, Conn., who, in the summer of 1869 purchased the carriage bolt machinery of Capt. Julius B. Savage, of Southington, and transported it to Cleveland, O., where they established what was known as The Cleveland Norway Bolt Co., on Girard Street, near the tracks of the C. C. C. & I. Railroad. In 1870 Mr. Samuel Armstrong became a member of the firm, and the style was changed to Bradley, Lewis & Armstrong. In 1872 Mr. Bradley sold his interest to Robert C. and Albert L. Colwell, at which time the style of the firm was changed to Lewis, Armstrong & Colwell.

In 1874 the business was purchased by Robert C. Colwell, Albert L. Colwell and Charles E. Collins, and continued under the style of Colwell & Collins. Various improvements were made at this time, and the future success of the enterprise seemed assured. A fairly prosperous business followed until March 12, 1892, when a disastrous fire occurred which resulted in a total loss of the buildings and seriously damaged the machinery. Under the style of the Norway Bolt Company

the company's product was conspicuously labelled "Superior Norway Bolts." There are tricks in all trades but ours, and some of their competitors averred that a prefix to the title, rendering it "Lake Superior" Norway Bolts would have been far more appropriate.

The upsetting machinery employed in their factory was Clark upsetters, built by James B. and Lucas Clark, of Plantsville, Conn.; which prepared the blanks cold for making full square Philadelphia carriage bolts from "Norway" iron rolled in Boston, Mass., and "Lake Superior" Norway iron rolled in Cleveland, from which sizes above $\frac{3}{8}$ were made. Soon after the fire the company built a new factory with modern improvements on Windsor Avenue, near the C. & P. Railroad tracks. A portion of the damaged machinery was restored and installed in the plant. The business was continued until 1896, when the factory was closed and the greater portion of the machinery was sold to the Fanner Manufacturing Co. of Cleveland.

THE LAMSON & SESSIONS COMPANY.
Cleveland.

The foundation of the extensive manufacturing business conducted by the Lamson & Sessions Company of Cleveland, Ohio, was laid at Mt. Carmel, Hamden Township, Conn., in 1862, at which time Thomas H. Lamson and Walter W. Woodruff of Southington, Conn., formed a co-partnership and began manufacturing pinched-neck or common carriage bolts for the market. Their factory was located on the canal railroad, about ten miles north of New Haven, and occupied a small building that had previously been used as an axle works. Their water power was derived from the abandoned New Haven and Farmington Canal, which was employed to run a sadly demoralized breast water wheel that

was out of balance and minus several buckets. It was not a strictly up-to-date plant, but it was run with tolerable success until 1864, when the business was sold to Peck, Stow & Wilcox Co., who removed the machinery and tools to their new factory building in Southington, and Mr. Lamson returned to his former position as foreman for J. B. Savage.

In 1865 Mr. Thomas H. Lamson entered upon a new venture, becoming a member of a firm known as Kennedy, Lamson, Holt & Dickerman, and doing business under the title of The Mt. Carmel Bolt Co., at which time they purchased the pinched-neck patent of Alvin Pond, issued April 11, 1865. Mr. Kennedy was a mechanic; Mr. Lamson, a practical bolt maker; Mr. Holt, a railroad passenger conductor, and Mr. Dickerman, a farmer. It was not a well-constructed combination to conduct a manufacturing business, and the partners failed to devote proper attention to the business. The following August of the same year, Mr. S. W. Sessions purchased Mr. John Holt's interest and during the fall, Mr. I. P. Lamson purchased that of Mr. August Dickerman; soon after, T. H. & I. P. Lamson and S. W. Sessions bought out Mr. John Kennedy, thus creating the combination that afterwards proved so prosperous. It should be mentioned that the Mt. Carmel factory was established and equipped in the building formerly occupied by Lamson & Woodruff, and that the old breast water wheel, not much improved by the lapse of time, was again pressed into service.

The style of the firm was changed to that of Lamson, Sessions & Co., and it did a successful business in Mt. Carmel until the fall of 1869, when the partners determined to seek a broader industrial field to bustle in, and chose Cleveland as the promising point.

There was no lack of gloomy forebodings among their old friends and neighbors concerning this great and seemingly rash undertaking, and even "Boss" Roswell A. Neal, an authority on such matters, being, as he was, prominently con-

nected with the big firm of Peck, Smith & Co., confidentially predicted that "the boys would not last long in Cleveland." The "Boss" was so sincere in his opinions that he took pains to impress them on a number of Messrs. Lamson & Sessions' valued employes, who accepted employment with Peck, Smith & Co., rather than take the risk of going "out West" and finding themselves out of a job in a few months. Among those who stayed behind were a nut machine foreman, Mr. Lyman S. Taylor; chief machinist, Mr. Abner Candy, and a few others. Mr. Leroy A. Gleason, however, could not be frightened. He removed to Cleveland as master mechanic with the outfit and remained with the firm for many years. He is now superintendent of the Upson Nut Co. of Cleveland.

The plant in Cleveland was fully established and equipped in 1870. It was located beside the tracks of the C., C., C. & I. Railroad and opposite the passenger depot of the A. & G. W. Railroad, the western terminus of that road at the time. The plant consisted of a two-story building, 150 by 60 in dimensions; a one-story forging room, 100 by 60 feet, connected with which were boiler and engine rooms, office building and spacious iron sheds for storage. The new plant and accessories were admirably arranged and the company met with gratifying success at the very beginning. Their business grew and prospered without a set-back until August, 1872, when the buildings were entirely destroyed by a most disastrous fire, though a portion of the machinery was preserved in fair condition.

The effects of the catastrophe were promptly overcome, however. A contract for clearing away the debris and the erection of new buildings was immediately made with Mr. J. T. Watterson, and at the expiration of thirty days the buildings were ready to receive the new machinery that had been ordered and received in the meantime. Although the machinery had been idle for the time being, the business

of the company had been continued almost as though nothing had happened. Temporary offices had been provided, and orders for future delivery had been so plentifully received that the new plant started up with more than enough work to keep it running overtime for months.

A steadily increasing business and an overcrowding of every department of the old plant, necessitated the erection in 1882 of the spacious buildings that the company now occupies, which cover the larger portion of the old stock yards on Scranton Avenue and the Big Four Railroad. These consist of a main building 400 by 80 feet, and three stories in height, with two three-story and two two-story wings running back towards the Big Four tracks, in close proximity to which are the necessary outbuildings, storage sheds, gas house, etc.

The factory proper is equipped throughout with the most modern machinery, tools and devices for the manufacture of not only bolts and nuts of every style and variety, but of a number of tools and implements that they make in large quantities.

A Harris-Corliss engine, 24 x 48, and a battery of four 16-feet by 60-inch boilers furnish power for the vast congregation of machines, which, while in motion, turning out bolts, nuts, rivets, wrenches and other useful articles by hundreds of thousands, present a bewildering and inspiring spectacle of human ingenuity and industry.

The arrangements for protection against fire in this model establishment are unsurpassed. The buildings throughout are provided with a network of water pipes filled with compressed air, which, when the slightest fire occurs, is ejected and replaced by a pressure of water by the operation of electric automatic valves. The city water pressure is reinforced by a powerful steam pump which receives water from immense storage tanks, and is also operated automatically. The entire system operates with the perfection of clock-work and the

automatic fixtures are so sensitive that the entire buildings can be flooded almost instantaneously. The boilers are provided with Engineer William Burk's patent smoke consumers, an arrangement that cokes the fuel before entering the furnace, thus consuming the gases, preventing a flow of smoke from the stack, which City Supervising Engineer C. H. Benjamin, under date of October 30, 1901, attests, is reduced to a minimum of 1-10 of 1 per cent. Mr. Burk has been in the company's employ for more than 20 years, performing his duty as engineer to the entire satisfaction of all concerned.

While the business affairs of this great corporation have always been conservatively managed, "Progress and Improvement" has ever been the motto of the experts having charge of the mechanical department. No device, ever so simple or unpromising, was too insignificant to invite their critical inspection; and, if they found one grain of improvement in a bushel of worthless inventive ideas, they felt well repaid for the labor bestowed on the gleaning. This uniform application to experiment and investigation has been rewarded by the production of a number of the most practical and valuable devices employed in their processes of manufacture, and furthermore, it has earned for the establishment the credit of having originated a number of processes and methods that have come into general use.

Beginning business as the manufacturers of common or pinched-neck carriage bolts, they soon made a marked and valuable improvement by producing common bolts, blued by machinery, with turned heads, thus originating a novelty which proved such a success that it was promptly imitated by other manufacturers. Their invention of the bluing barrel and furnace was in the year 1868.

They were the first carriage bolt manufacturers in America to roll screw threads on stove and kindred bolts, and to successfully forge, hot from the rod, carriage, machine and other bolts.

They were the first, west of the Allegheny Mountains, to make tire and stove bolts for the trade, beginning in 1870 with the Waterbury Farrel Foundry Machine Co. automatic tire heading machines, and, in a few years, adding shavers, slotters and threaders, which were the first automatics of the kind used in the West.

In 1874 they began making full-sized carriage bolts of standard and Norway iron, using a J. Noyes Smith cold up-setter, purchased of the Cleveland Nut Co. and so reconstructed as to do satisfactory work.

In 1887, square-head machine bolts, skein bolts, lag screws, and gimlet-pointed coach screws were added to their list, and the same year they purchased the machinery of the Canfield & Sutliff Wrench Co. and began making a full line of knife handle, engineers', standard and agricultural monkey wrenches, also automobile and bicycle wrenches, etc., in which they built up an extensive trade.

In 1888 appliances were added for the manufacture of Rose, "blackberry" or fancy cast nuts for the stove trade. These were invented and patented by Supt. William J. Keep, of the Michigan Stove Co., Detroit, Mich. They had been made in small quantities until The Lamson & Sessions Co. began to manufacture them extensively and introduce them to the general market, where they found a ready welcome.

The Lamson & Sessions Co. were the first to press, simultaneously, two stove nuts from a single rod, a process that has not yet been adopted by any other factory.

The uniform and continued success of this great industrial corporation testifies to the value of mechanical skill, ingenuity and business ability judiciously united and energetically employed.

In dealing with the labor questions that are frequently presented in the industrial world, The Lamson & Sessions Co. have been so eminently successful that they have wholly avoided discontent among their numerous employes. They

adhere to the maximum that "the laborer is worthy of his hire" and they constantly aim to pay the highest possible wages and to secure the highest possible grade of service in their every department. They regard their employes as the most important part and parcel of their works and nothing is neglected that is deemed essential to their contentment and wellbeing. On June 1, 1903, The Lamson-Sessions Company voluntarily advanced the wages of their employes by granting them ten hours' pay for a nine-hour day's work. This was the first bolt and nut company in America to make this concession to their employes. The quaint and highly appreciated old New England custom of presenting a plump Thanksgiving turkey to each employe has been religiously observed by the company for many years, as it is by many others, and the annual distribution always presents a scene of merriment and good feeling to witness which is worth a good deal more than twice the price of admission.

"To gladden hearts and life to cheer,
Thanksgiving comes but once a year."

The above lines are credited to an employe on one of these occasions, and the following to another:

"To furnish turkeys and good cheer,
Thanksgiving comes just once a year."

Isaac P. Lamson is the only surviving one of the three original organizers and early promoters of the industrial enterprise that bears their names.

Mr. Lamson is not the only veteran still in the harness; for in the employ are a goodly number of gray beards, who have grown up with the business, each one of whom could contest for the title of "Nestor"; each one of whom is an expert and each one of whom is proud of his ability and antiquity. These are called "Lamson's Grays" by their fellow employes, and they are all pleased with the title. A few of the older ones began service with the original company in Mt. Carmel, a fact that entitles them to special distinction.



S. W. Sessions

The Lamson & Sessions Co. was incorporated as a joint stock company in 1882. Thomas H. Lamson died August 17, 1882; S. W. Sessions died September 7, 1902, at which time the officers of the company were: S. W. Sessions, president; I. P. Lamson, vice-president; John G. Jennings, treasurer; H. C. Holt, secretary; F. C. Case, superintendent.

At the annual meeting of 1903 the following officers were elected; Isaac P. Lamson, president; Frank C. Case, vice-president; John G. Jennings, treasurer; H. C. Holt, secretary.

SAMUEL WASHBURN SESSIONS.

Conspicuous among the men of genius and business sagacity, whose lives were contemporaneous with the growth of the bolt and nut industry of America, was the late Samuel Washburn Sessions of Cleveland, Ohio.

Mr. Sessions was born in Burlington, Conn., October 8, 1826. On completing his education, he began his business career as secretary and treasurer of The Miller Manufacturing Company of Miller's Station, Conn., one of the earliest establishments to engage in the exclusive manufacture of bolts and nuts and one of the many to meet disaster and abandon the field. Mr. Sessions held his position until the affairs of the company were closed up, after which he and Mr. Thomas H. Lamson took charge of the plant and continued manufacturing bolts and nuts under a contract with The Plant Manufacturing Co. of Plantsville, Conn. This arrangement continued a year, at the expiration of which Mr. Lamson retired and Mr. Sessions held the contract for another year, when he also abandoned the business which had failed to yield satisfactory results.

Soon afterwards Mr. Sessions secured a situation as accountant and bill clerk for the Peck, Smith Co. of Southington, afterwards The Peck, Stow & Wilcox Co., where he

remained until he and others conceived the idea of organizing what was known as The Lamson & Sessions Co. of Mt. Carmel, Conn., which, in the year 1869 was removed to Cleveland, Ohio, where it became one of the largest, best appointed and most prosperous establishments of the kind in the country.

On establishing the company in Cleveland, Mr. Sessions was chosen as president, a position that he occupied and the duties of which he discharged with marked ability up to the time of his death, which occurred September 7, 1902.

Notwithstanding the time and attention exacted in the conduct of the large and steadily increasing industry, Mr. Sessions was enabled to successfully engage in many other business and financial enterprises. He was president of The Union Rolling Mill Company, a director in several banking institutions and officiated in managerial capacity in other business ventures.

Although a very busy man, Mr. Sessions devoted much time to public and benevolent affairs. He served as a member of the Public School Sinking Fund Commission, as a member of the Water Works Board, as a member of the Park Board, and was a valued member of the Chamber of Commerce.

Mr. Sessions was always interested in church and charitable work. He was a trustee of the Pilgrim Church for many years, and a director and liberal contributor to the Jones Home and other benevolent institutions.

THE UPSON NUT CO.

Cleveland, Ohio, and Unionville, Conn.

This immense manufacturing establishment had its origin in Unionville, Conn., in 1854, and its nucleus was a small factory owned and operated by Mr. Dwight Langdon, who manufactured carriage bolts from square iron, employing four hand

headers. These were supplied by a single furnace, constructed square, and giving each workman a separate side to heat his iron. The remainder of the outfit consisted of a home-made blower, a rounding press, a turning lathe, two single head cutting lathes and two horizontal single spindle tapping lathes. The power was furnished by the Farmington Water Power Company. The value of the entire plant was about \$1,500, and its daily capacity was 3,000 carriage bolts.

Early in June, 1857, Mr. Langdon purchased from Mr. Herman Chapin the first successful Chapin bolt heading machine ever operated, and began heading carriage bolts by machinery. The dies of this machine were V shaped, straight through, both ends being used for holding the blank while forming the head. Later on Mr. Langdon added a second Chapin header to his equipment. Mr. Langdon purchased his supply of nuts from outside manufacturers, using the cold pressed variety. Several nuts were strung on small rods and heated at the same time, and then crowned and finished with a hand hammer, while held on a punch. The prices paid for this work were, per 100 nuts, count:

1-4	5-16	3-8	7-16	1-2	bolt size
5	6½	8	10	11	cents.

These figures were given by Samuel Frisbie, May 29, 1887. In 1859 Mr. Langdon added cold pressed nut and washer machinery to his plant, which he purchased of Capt. J. B. Savage.

Mr. Langdon died April 30, 1860. Soon after the death of Mr. Langdon, the entire plant and business were purchased by Andrew S. Upson and George Dunham, who made various improvements in the machinery and equipments, but still continued to hand head their Norway iron and other special bolts. The noisy rounding presses and other inconvenient appliances were, however, discarded. In 1863, a company, composed of Geo. Dunham, Andrew S. Upson, Samuel Frisbie, Dr. William H. Sage and Gilbert J. Hines, purchased the entire inter-

ests of Philip Koch's patent on a hot forged nut machine. On July 14, 1864, these gentlemen organized the Union Nut Co. with a capital stock of \$30,000, and began manufacturing hot forged nuts.

In the following year, 1865, Mr. Dunham sold his entire interests in the business to Mr. Upson, who, after running it until January 1, 1866, sold the entire plant and business to the Union Nut Co., at which time the capital stock was increased to \$50,000.

This company acquired a number of other valuable patents on hot forged nut machinery, and so shrewdly managed their affairs that they virtually controlled the trade on this class of goods and on the machinery used in their manufacture for a number of years.

In 1872 The Union Nut Company established a western branch, by forming a co-partnership with The Aetna Nut Company of Southington, Conn., and The Lamson & Sessions Co. of Cleveland O. This organization was known as The Cleveland Nut Co., and the following officers were elected: S. W. Sessions, president; Samuel Frisbie, secretary and treasurer; Horace A. Allen, manager, and Leroy A. Gleason, superintendent, and a large factory building was erected and equipped on Scranton Avenue and the C. C. C. & I. Railway. Soon after this the interests of the Aetna Company were purchased by the Union Nut Company, and, in 1877, the interests of the Lamson & Sessions Company were also purchased. At this time the capital stock of the company was increased to \$100,000; the facilities were also materially increased and improved and sales departments were established in New York City and Chicago. In January, 1883, under a special charter, granted by the Connecticut legislature, enlarging the powers of the company, its name was changed to The Upson Nut Company, and during the following June the capital was again increased to \$250,000. Another increase in capital occurred in 1889, advancing it to \$300,000, at which it has remained,

although inadequately representing the enormous volume of trade and the material interests of the company.

In 1890 this company absorbed the extensive bolt works of Hotchkiss & Upson, Cleveland, and, soon after, the business and machinery of Welch & Lea of Philadelphia, manufacturers of the celebrated Coleman Eagle Carriage bolts, which was removed to Unionville, Conn., and Cleveland, and employed in making fancy bolts, including the "Eagle Philadelphia" tire and carriage and the so-called "Anvil" carriage bolts.

"Progress" has been the watchword of this enterprising company, and throughout its entire history it has never taken a backward step. Its fixed policy has been to utilize the best of everything obtainable, in labor, material and methods, and to produce the best of everything in its various lines.

It is not too much to say that "the hand of the master" has been conspicuous at every stage of the progress of this remarkably successful company, and not one of the many able men who co-operated with him in his many undertakings will deny President Upson "the lion's share" of credit in building the fortunes of the magnificent industry with which he has been so long and closely associated.

It should be added that the Upson Nut Co. of Cleveland and Unionville stands foremost among the great industrial establishments of the kind in the world. Its supremacy has been gained by a long series of business, mechanical and financial achievements, carefully planned and ably executed.

In 1880 this company introduced the "bastard" carriage bolt which commanded an unprecedented sale for a number of years and is still a staple bolt in the market, and used by manufacturers of agricultural implements, etc.

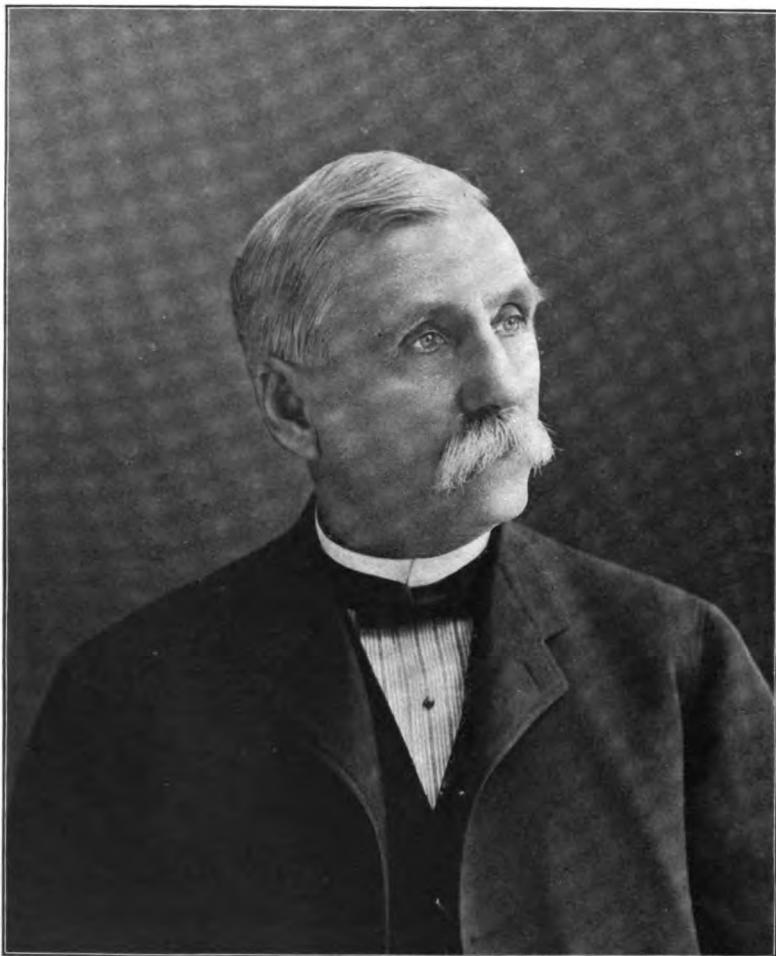
In 1889 they placed the "Woodford" fin-head bolt on the market, which also secured a large trade in the same line as the bastard bolt. The same year they began cold forging carriage, machine and other bolts, a process they have so

extensively improved that it is in a fair way to supersede the hot forging process.

The company manufactures every variety of cold and hot pressed and forged nuts and washers; all styles of carriage, machine, plow, tire, stove and fancy bolts, carriage hardware, cutlery and boxwood rules.

Mr. Upson was elected president and treasurer of the company Sept. 3, 1864, and has held the former office continuously since that time. On March 6, 1866, he resigned the treasurership and Samuel Frisbie was elected to the position. Dr. William H. Sage, now residing in Woodbury, Conn., was elected secretary Sept. 3, 1864, and retained the position until Jan. 18, 1875, when he resigned and was succeeded by Mr. Frisbie. The positions of secretary and treasurer were held by Mr. Frisbie from Jan. 18, 1875, until his death, which occurred Dec. 9, 1897. C. H. Graham was elected treasurer Dec. 11, 1897, and still occupies the position. Mr. Graham has been a member of the company since its organization and has largely contributed to its success. W. A. Hitchcock was elected secretary Dec. 11, 1897. Mr. Hitchcock began serving the company as invoice clerk in 1875, and has been an able assistant in conducting the company's affairs. Mr. Upson and Dr. Sage were members of the original board of directors and are still members of the directorate. Their associates in the present board are, Charles H. Graham, J. L. Varick, D. A. Upson and W. J. Upson (sons of President Upson) and W. A. Hitchcock.

On March 30, 1890, the entire works at Unionville were destroyed by fire. They were promptly replaced by substantial brick buildings.



Andrew S. Myron

ANDREW S. UPSON.

Andrew S. Upson was born in Burlington, Conn., June 16, 1835, where he was reared and schooled after the approved fashion of Yankee boys in the early days, and where he was subjected to a system of training which taught them that industry and application are the avenues to success in every stage and condition of life. That he never forgot or neglected these valued precepts is proved by the success of his many undertakings in later years.

Young Upson had a natural talent for trade and traffic which induced him to embark in the mercantile business at an early age and his first venture in this direction was to take the road as a traveling salesman. Providing himself with a horse and wagon and securing a small stock of bolts and nuts from the factory of Dwight Langdon of Unionville, Conn., he began making short trips among the cross-road blacksmiths and wagon makers to introduce his goods. It was practically a new line of trade. Bolts and nuts were but little known as an article of merchandise in those early days, and to secure purchasers even for small quantities of such a novelty, often taxed the patience and the ability of the salesman to the utmost limit. Nevertheless young Upson was not traveling about the country for pleasure nor for his health, but for the purpose of selling his wares, and he applied himself with so much earnestness that he soon secured a paying trade in the limited territory that he had canvassed, and later on procured two horses and a larger wagon and sought broader fields. In the course of time he established a highly prosperous trade that extended from Long Island Sound through all of the New England States. After securing such a profitable and increasing market the young salesman decided to embark in the bolt and nut business on his own account, and as a result he became interested in the Langdon factory, and immediately shared in the active management of the several branches of the

business, acquiring a knowledge of the various details, but giving special attention to increasing the volume of trade.

Mr. Langdon died in 1860, and soon after Mr. Upson and Mr. George Dunham formed a co-partnership and purchased the factory. Later on Mr. Upson purchased from Mr. Dunham his entire interests in the business and also the valuable patent rights on a forge nut machine invented by Philip Koch. Mr. Upson then organized the Union Nut Company, of Unionville, of which he was made president and treasurer. This company was subsequently reorganized as the Upson Nut Co., with factories both in Unionville and in Cleveland, Ohio. The latter factory is now the largest forged nut establishment in the world.

At an early date Mr. Upson also embarked in the manufacture of boxwood rules and levels, erecting a large factory for the purpose in Unionville. Other branches have been added to this establishment, including cutlery, carriage hardware, etc. Beside these Mr. Upson is heavily interested in several large manufacturing and other establishments in Cleveland, among which are the Union Rolling Mill Co., of which he is president; and a number of other leading banking and financial institutions of the city.

In public life, in his native State, Mr. Upson has been repeatedly honored with political preferment, unsolicited, having faithfully served both as representative of the Farmington district in the State Legislature and also as a member of the State Senate. At all times during his business life Mr. Upson has taken an active interest in public affairs and benevolent objects, aiding in their advancement and support with unstinted generosity.

During the past few years Mr. Upson has traveled extensively, both at home and abroad, and during last year made an extended trip to Egypt, visiting the pyramids, the ancient cities, and other objects of interest.

THE ARMS-BELL COMPANY.**Youngstown.**

Our Lady Fortune's ruling propensity for playing at shuttlecock with those who ventured to embark in the bolt and nut business frequently checked the career and consigned to oblivion, many promising enterprises in the line, and often at the very time when they had apparently reached the zenith of prosperity. Conspicuous among those that were subjected to harassing experiences was what, after a multiplicity of changes, became known as The Arms-Bell Co., of Youngstown, Ohio.

Its foundation was laid in 1864, when the Lake Superior Nut & Washer Co. was organized in Youngstown, with G. B. Simons, president; J. G. Butler, treasurer, and F. B. Williams, secretary.

In 1867, at the expiration of three years of unsatisfactory experience, this company transferred its entire interests to a newly hatched enterprise, known as the Youngstown Nut & Washer Co., incorporated by Edwin Bell, A. B. Brownlee, W. H. Wick and others. This company struggled with fate, against overwhelming odds, until 1869, when its entire belongings were sold to Freeman O. Arms, Edwin Bell and J. B. Wilder, who at once became sponsors for the firm of Arms, Bell & Co. One year later, in 1870, this company consolidated with the Youngstown Manufacturing Co., which was engaged in the manufacture of bolts and nuts, and the title was changed to the Glencoe Iron Works; but retaining the firm name of Arms-Bell & Co., and William J. Hitchcock and H. K. Wick became members of the company. The addition of the machinery of the Youngstown Manufacturing Co. to the plant largely increased and improved the facilities, and the production of the factory was correspondingly multiplied in the various branches. Soon after this consolidation W. H. Wick disposed of his interest to Frank Williams; and out of this

and other transactions, sprung another entirely new company, which was launched in October of the same year, and called the Arms-Bell Co., with Frank Williams, president; J. B. Wilder, vice-president, and W. H. Wick, secretary and treasurer. The company occupied the same building as Arms, Bell & Co. At this time other extensive additions were made to the works. New and improved machinery was introduced and a general rearrangement of the factory was made. On February 1, 1882, the Arms-Bell Co. purchased of Arms, Bell & Co., the rolling mill known as the "Grasshopper," and with it the entire interest of Arms, Bell & Co. Another age of improvements was inaugurated, which was completed on December 14, 1882, and at 10 o'clock the same night the mill lay a mass of ruined machinery and embers. The loss was total. Not a foot of the building remained to tell the sad story of the conflagration. The severity of the blow, however, did not discourage the owners. The debris was immediately removed, building was begun and at the expiration of fifty days a new mill was completed and manufacturing was resumed.

On January 26, 1886, the Grasshopper mill was again destroyed by fire and the ruin was nearly as complete as before. After this disaster it was not thought advisable to rebuild. A large portion of the machinery was removed to the bolt and nut factory, where it was again put in operation.

The factory building was conveniently located, adjoining the tracks of the Pennsylvania Railroad Co. Side tracks connected the building and warehouses with Brown, Bonnel & Co.'s mills, from whence they received a large share of the iron used in the manufacture of nuts and bolts. Owing to the several reverses the concern passed into the hands of Edwin Bell and E. L. Wilder as receivers in May, 1885. The interests of the company were managed by them until February, 1887, when the plant was purchased by a new company consisting of Myron Wick and others, who operated the business

under the corporate name of Arms, Bell & Co., with the following officers: Myron Wick, president; W. H. Baldwin, vice-president and treasurer, and E. L. Wilder, secretary. The company manufactured every description of bolts and nuts, both cold, punched and hot pressed; washers, carriage and machine bolts, lag and skein screws and railroad track bolts, which were turned out in large quantities. The company was in a highly prosperous condition and continued to thrive and increase its business until on election day, the first Monday in April, 1889, when the works were again completely destroyed by fire, nothing escaping the flames but a small office which stood some distance from the main building. Three months later the entire machinery, stock and iron, all more or less damaged, was sold to Cleveland and Philadelphia parties and disposed of in the following manner: Representatives of The Bourne & Knowles Manufacturing Co., The Lamson & Sessions Co., The Upson Nut Co., and The Lake Erie Iron Co. of Cleveland, and Hoopes & Townsend of Philadelphia, met at the Tod House, Youngstown, proceeded to the ruins and tabulated and appraised the entire machinery and material, which was then sold at auction and knocked down to the highest bidder. Frank R. Scofield acted as auctioneer. Only representatives of the several companies were permitted to bid, except for the scrap iron, which was sold to Joseph Hays of Cleveland. Thus ended one of Youngstown's most promising enterprises.

YOUNGSTOWN BOLT COMPANY.

Youngstown.

The Youngstown Manufacturing Company was organized in 1901, with the following officers: Thos. McDonald, president; Hugh B. Wick, vice-president; Edwin McEwen, secretary and treasurer. At the expiration of one year the follow-

ing officers were chosen: Edwin McEwen, president; T. B. E. McVay, vice-president; Whitney Warner, secretary and treasurer. They erected a large well ventilated brick building at Struthers, about five miles east from Youngstown. The factory is well equipped with Acme, National and Burdick machinery for the manufacture of nuts, bolts and rivets. One notable feature of their equipment is an electric traveling crane, which is so arranged with overhead tracks and switches that a boy operator sits comfortably in a small car and conveys the product from place to place about the building as required with the utmost despatch, thus saving a great deal of time and labor. This is the first machine of the kind to be used in a bolt and nut factory and the second one in America. Another valuable device is an automatic arrangement attached to Acme heading machines, which is similar to the automatic roller feed employed on tire bolt heading machines. It is used in heading boiler and bridge rivets. Rods thirty feet in length are heated in an oil furnace thirty-four feet in length, and fed into the machine by this automatic arrangement, and rivets are turned out at the rate of sixty per minute. This is also the second device of the kind now in operation.

During February, 1904, the company was incorporated for \$650,000, with \$250,000 preferred stock, under the firm name of the Youngstown Bolt Co. The officers were: A. E. Adams, president; R. C. Steese, vice-president; C. J. Wick, secretary and treasurer; J. C. Wick and J. D. Hine, directors. This new organization installed up-to-date cold forging machinery. The company continued an unsatisfactory business until January, 1905, when its affairs were placed in the hands of a receiver, with a view to another reorganization. W. G. Carmen was appointed receiver, and a number of wealthy capitalists of Youngstown decided to furnish capital to increase the facilities of the plant and continue the business under new management.

THE GARRETSVILLE BOLT COMPANY.***Garrettsville.***

Quite typical of the early history of the bolt and nut business, was an enterprise fathered by Mr. George Fuller, of Southington, Conn., in 1865. He invented and had constructed an ingenious machine for forging nuts, yclept "The Fuller Nut Machine," the value of which he determined to test at some place west of the Alleghanies. He visited a number of western towns, but finally found willing investors in what promised to be a "big thing" in Warren and Youngstown, Ohio. Prominent among these were W. H., better known as Harry, and Edward Steadman, of Unionville, Conn., who undertook the work with so much energy that a company was soon formed and a factory was established at the little town of Garrettsville, on what was then the Cleveland & Mahoning Valley Railroad. The company was called the Garrettsville Bolt Co. But what's in a name? especially when the majority of the incorporators, stockholders, managers and what not, that had been induced to subscribe for stock, were plain old farmers and stock raisers wholly destitute of business knowledge and still more ignorant, if possible, of the science of manufacturing bolts. It was as much as they could do to tell a bolt from a crowbar, but they were so wise in other ways that they insisted upon "having their say" in all matters, which say, it goes without saying, was uniformly wrong, from a business point of view. Of course, each one of the stockholders wanted to boss the whole business. But why dwell on the painful subject? After a singularly brief period of experimenting, which involved a world of bad temper and disputes, the affairs of the concern were closed, the effects were sold at a great sacrifice and the bucolic investors returned to their farms, wiser, if not richer men. For a number of years afterwards Harry Steadman had displayed on the wall of his humble quarters a hexagon case

clock, which was all he saved from the wreck, and to which he used to call the attention of his visitors with the remark that it cost him \$1,200. In later years Harry Steadman told many amusing stories of his Garrettsville experience, and he always declared that the engine was the straw that broke the camel's back. It seemed that the interests of his hayseed partners were wholly centered in the old engine. They would gather about it and watch it by the hour, and so long as it was running they did not care a "darned thing" whether the other machinery was moving or not. They openly declared that it "beat a threshin' machine all to shucks," and they were always in such distress about it for fear that it should get out of order that it finally became a general bone of contention.

THE COLUMBUS BOLT WORKS.

Columbus.

The nucleus of this company was a small bolt factory established in Greenfield, Ohio, by Col. James Simpson and Mr. F. G. Waddell in 1868. The machinery used was principally a duplicate of the old Philadelphia Norway Bolt equipment, the forging being done under the "Oliver." By this crude process a very industrious operator could produce a daily average of from 1,000 to 1,200 bolts. The same energy expended on modern machinery would yield from 7,000 to 8,000 of the same class of bolts.

In 1870, Mr. R. E. Neil and Major W. W. Williams became interested in the business, and the machinery was removed to a new building on the outskirts of Columbus, Ohio, where additions were made to the equipment and a number of expert hands from Philadelphia were employed. Soon afterwards the process of upsetting from round iron was installed and instead of the round portion of the bolt being made from the square, the square was made from the round.

In 1874 the company was incorporated, at which time Mr. H. A. Lanman purchased the interests of all the partners, except Mr. F. G. Waddell, Mr. Lanman becoming president and Mr. Waddell secretary and treasurer of the organization. At the present writing the works employ about 350 hands. Improvements in the production of steel have been such that it has superseded Norway iron, and the bulk of the bolts are now made of either open hearth or Bessemer steel. During the past year the company exported its product to England, Scotland, Australia, South Africa, Java and many other foreign markets. The officers of the company are: H. A. Lanman, president; W. K. Lanman, secretary, and W. C. Buchanan, treasurer.

The marked advance in the progress of this enterprising company has chiefly occurred since Mr. H. A. Lanman became identified with its fortunes. It is worthy of note that Mr. Lanman is a native of Connecticut, the State that has been so prolific of bolt and nut manufacturers. He was born in Norwich, not remote from the township of Southington, which was the original fountain head of the bolt business in America; Mr. W. K. Lanman, his son, who has charge of the mechanical department of the works, and who is both a theoretical and practical mechanic, graduated at Cornell University in 1895. Mr. W. C. Buchanan, treasurer, was formerly engaged in the manufacture of bolts in Lancaster, Pa., and has been with the present company since 1884.

THE UNION STEEL SCREW COMPANY.
Cleveland.

The Union Steel Screw Co. is one of the largest industrial enterprises in Cleveland. Their spacious plant, equipped throughout with the most modern machinery, is located at the corner of Payne and Case avenues. The company was organ-

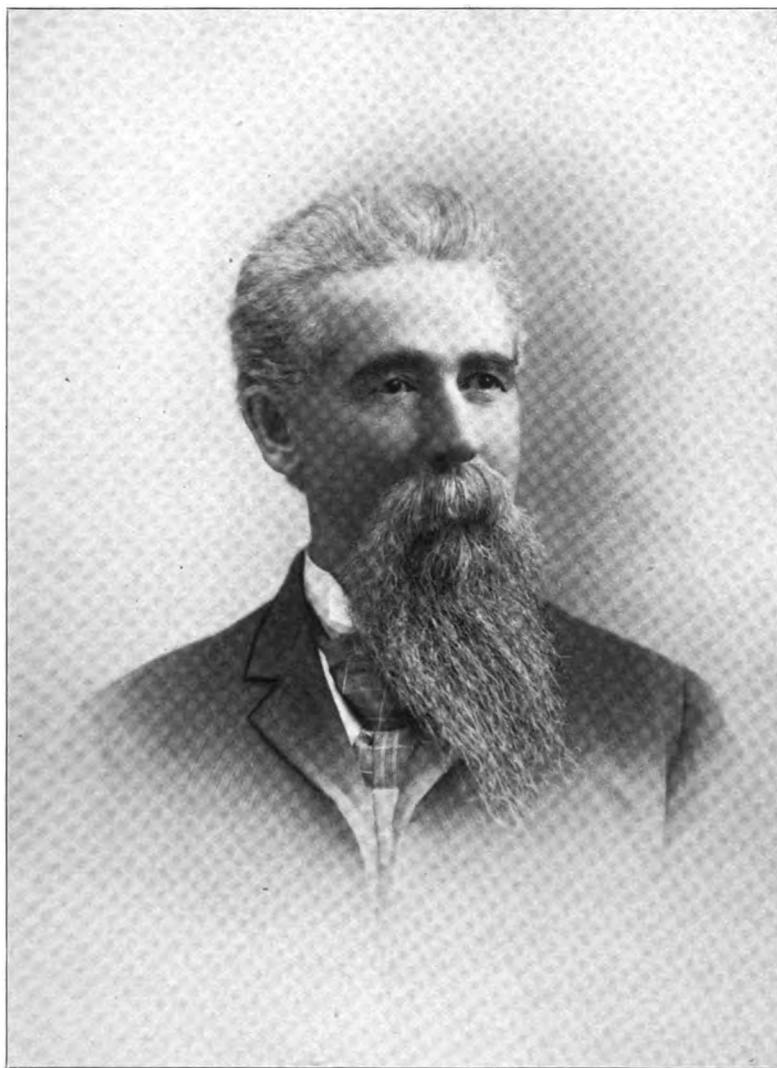
ized in 1872, through the instrumentality of Mr. J. A. Bidwell, the inventor of the ingenious "wishbone header." Mr. Bidwell was made superintendent of the works, a position that he has held with marked ability up to the present time. The company makes a specialty of wood screws, and the smaller sizes of nuts and bolts.

The present officers are: Fayette Brown, president; S. Sickles, secretary; J. A. Bidwell, superintendent.

ISAAC PORTER LAMSON.

Isaac Porter Lamson was born in Mount Washington, Berkshire County, Mass., September 2, 1832. His boyhood years were spent on a farm, where, after the fashion of the earlier farmer boys, he toiled during the summer months and applied himself to study in the district school during the winters. In those days the New England farmers had no fancy theories concerning the hours spent in toiling. Labor was honorable and necessary, and those who applied themselves to it, without counting the hours, uniformly met with a satisfactory reward. Young Lamson cheerfully abided by these theories and toiled at farming until the age of eighteen, when he paid his father \$150 for his time, which was paid in cash, the April before he became twenty-one years of age. Then he sought outside employment, and worked for a short time as a woodchopper, earning a salary of six dollars per month and board. Later on he found more lucrative employment, and, by frugally husbanding his earnings, he accumulated a moderate store of wealth, which enabled him to embark in the manufacturing business with his uncle, Henry A. Miller, and became a "capitalist" on a very limited scale.

In 1854 he purchased a small interest in the Miller Manufacturing Company of Miller's Station, Conn., securing employment in the factory, which afforded him an excellent



J. P. Dawson

opportunity to develop his natural mechanical genius. During the following three years he mastered the trade of bolt and nut making and also acquired a fair knowledge of the construction of machinery and general mechanical arts. At this time young Lamson met his first business reverse, occasioned by the failure of the Miller Manufacturing Co., in which he had invested nearly all of his savings. The wreck was so complete that the company passed from existence and the stockholders lost their entire investments, with the exception of six per cent., returned to them after the affairs of the company were settled.

Though the failure impoverished young Lamson, it did not check his buoyant spirit, nor retard his energy. On the contrary, he soon found employment with J. B. Savage, of Southington, and subsequently with the Plant Manufacturing Company of Plantsville, Conn., where he had improved advantages to increase his knowledge of machinery and mechanical skill. He remained with this company until 1862, when he accepted the position as bolt head turner with William J. Clark & Co., of Milldale, Conn., afterwards known as Clark Bros. & Co. While thus engaged, he and Martin Barnes jointly contracted with the company to attend to the entire labor department of the factory, it being provided that the company should furnish the machinery, power and material, and that Lamson and Barnes should furnish the manual labor and deliver the finished product to the limit of the capacity of the works.

This arrangement was terminated in 1868, when Mr. Lamson, in company with his brother, Thomas H. Lamson, and Samuel W. Sessions, established the Lamson & Sessions Company at Mt. Carmel, Conn. During the following year, 1869, the company removed to Cleveland, Ohio, where the foundation was laid for the magnificent works of the Lamson-Sessions Company of to-day, of which Mr. Lamson is now the president.

Since the creation of the company, Mr. Lamson's attention has been chiefly confined to the machinery and manufacturing departments of the business, involving duties for which he was amply qualified by his early mechanical experience and training. Of the vast number of improvements in machinery and devices for manufacturing bolts and nuts, during the last half century, few, if any, of them have escaped the critical inspection and careful study of Isaac Lamson. Always keenly on the alert for new inventions and novel ideas in the construction and adaptation of mechanical devices, his practical eye never failed to discover their merits or detect their faults. None of the numerous valuable machines in the mammoth factory of The Lamson-Sessions Company was placed there without the sanction and approval of Mr. Isaac Lamson, and it is admitted that he has rarely, if ever, erred in passing judgment on the merit of a new invention. Though not an inventor, Mr. Lamson is quick to comprehend the merits or faults of the inventions of others.

Although Mr. Lamson's attention has been closely confined to the bolt and nut business, he is also connected with a number of other extensive commercial, manufacturing and financial enterprises in Cleveland and elsewhere.

Notwithstanding the pressure of business, Mr. Lamson has never neglected what he regards as the duty of every citizen to share in the transaction of public and political affairs. In 1876, he was a member of the Centennial council, and he has served on several occasions as a delegate to local, State and national conventions of the Republican party, of which he has always been an active member. At the convention that first nominated Hon. William McKinley for President, Mr. Lamson was a member, and McKinley was his first and only choice.

Mr. Lamson has contributed in many ways to the material growth and prosperity of Cleveland, and is deservedly recog-

nized as one of the most enterprising and progressive citizens of the metropolis of Ohio. To worthy charitable objects, his assistance has, at all times, been generously bestowed.

HOTCHKISS & GAYLORD BOLT & NUT WORKS. Cleveland.

In 1874 Charles A. Hotchkiss of Plantsville, Conn., and Philip Gaylord of Southington, Conn., purchased a portion of the second-hand machinery of the suspended Plant Manufacturing Co., which they removed to Cleveland and established a bolt and nut factory on Carter Street, under the style of the Hotchkiss & Gaylord Bolt & Nut Works. With its old machinery and appliances, it was anything but a model plant; but it was licked into shape by the capable foreman, Fred C. Smith (now superintendent of the Upson Nut Co. bolt department), and soon took a place among the new industrial enterprises of the city with a tolerable prospect of success. All but two of the employes in the factory were Germans and on this account it was promptly christened "der vater land" by wag-gish craftsmen in the other factories, a name which clung to it till the end.

A stroke of economy in labor was made by arranging the box die headers in pairs, thus enabling three men, a heater and two headers, to perform the work that previously required four, the bolts being formed on one machine and passed to the other to be finished. This method was soon improved upon by constructing a new machine, provided with two feed gaps, embodying the principles of the single machine, but still further economizing in labor, as it could be run by a single operator, who formed the bolt by one blow in the first set of dies and finished with two blows in the second.

The company also had one of Micah Rugg's primitive heading blocks, known at the time as the "anvil bolt header,"

which was operated with a hand hammer and crowner, by a stalwart son of Erin, named Kelly. Mr. Kelly was proud of the old device and of his skill, and he often asserted that he could make "the finest bolt iver made, wid siven strokes of the hammer."

It was in this factory in 1877 that Foreman Fred C. Smith brought out and patented his excellent heading machine, known as the "Smith header." This machine embraced the principles of the two-gap header, but was improved by combining the dies in a single gap, by which means the bolt was formed, with one blow, in the lower groove and finished with two blows in the upper. The work was completed without a second heating of the metal, and the two operations were continuous. The machine was operated with clutch mechanism, and Mr. C. W. Durschlag, an expert bolt maker in the factory, was the first to successfully feed the machine while in continuous motion. After a little practice, he produced 7,000 5-16 square-headed bolts per day.

In 1882 Mr. Andrew S. Upson purchased the interest of Mr. Gaylord and the works were moved into the buildings vacated by The Lamson & Sessions Co., under the familiar title of Hotchkiss & Upson, which continued until 1890, when Mr. Hotchkiss' interests were absorbed by the Upson Nut Co.

KEITH & SMITH
Cleveland.

In 1874, Patrick Keith and Major Smith built a small factory on Warden Street, Cleveland, and began manufacturing carriage and fancy bolts, using the Philadelphia system. Two years later Smith sold his interest to Keith, who then formed a co-partnership with George Bartley. In 1871, Bartley bought Keith's interest and took as a partner, Hugo

Schipka. This partnership continued about two years, when they closed out entirely.

In 1879, Patrick Keith, still having faith in the bolt business, commenced manufacturing fancy head, carriage, spring and elevator bolts and taps and dies, at Kamm's Corners, Rockport, Cuyahoga County, Ohio, where he conducted the business in a small way, for twenty years. In 1900 he sold his machinery to The Lamson-Sessions Co. of Cleveland.

THE CHAPIN BOLT COMPANY.

Cleveland.

"We came, we saw, and were overcome." Rendered in this fashion, "Cæsar's thrasonical brag" would practically serve to give the entire history of this unfortunate company.

The Chapin Bolt Company succeeded Corrigan & Smith, a company organized by James and John Corrigan and J. Noyes Smith for the purpose of manufacturing hot pressed nuts with Smith's machinery. The company occupied a building vacated by the defunct Rhodes Rivet Co., on the old River bed at the foot of Taylor Street, Cleveland. After two years of unprofitable business, Smith withdrew from the firm, at which time the nut machinery was sold to The Cleveland Nut Co. A year later The Chapin Bolt Co. was organized by George Chapin, Marcus A. Hanna and Robert R. Rhodes. This company purchased the remaining machinery and occupied the same building, which they provided with machinery for making bolts, nuts and rivets. Their outfit of heading machines consisted of five Chapins, three Olivers and three square headers. They also had two Fuller nut machines. The business and financial affairs were conducted by Mr. George Chapin and Mr. Philip Chapin was appointed manager of the factory. Mr. George Chapin died August, 1881.

In 1883 Mr. Hanna gained control of the business by pur-

chasing Mr. Chapin's stock of his widow. At this juncture Mr. Hanna undertook to put more life into the business and place it on a paying basis. Mr. George O. Baslington was engaged to take charge of the business, and large sums were expended to improve the machinery and methods of manufacture. But in spite of all efforts fate seemed to frown on the enterprise from the very beginning.

A former employe in the factory, in speaking of its affairs, said that everything seemed to go wrong, even to the time clock, designed to keep tab on the night watchman. A number of watchmen were employed from time to time, neither of which seemed able to keep a satisfactory record on the time clock. Finally a green, but apparently intelligent and faithful German was employed, and, for a wonder, the record of the erratic clock was found correct every morning, indicating, of course, that the new watchman was a sleepless guardian of the premises. In the course of events, however, it happened that the engineer was obliged to report unusually early one morning, to make repairs on the engine. After a deal of trouble and pounding at the door, he was admitted by the faithful watchman, who was less than half awake, and then it was discovered that he had so completely succeeded in tampering with the patent time clock that he was enabled to take nearly full night's rest, and trust to the testimony of the clock, to prove that he had been wide awake and on deck during the long, weary hours intervening between dusk and dawn. While the green German's exposure disqualified him as a watchman, it testified to his ingenuity, for he had arranged an electric battery so that it would awaken him at the proper hour to press the button of the clock, and the device had never failed to operate perfectly.

Possibly other and more important departments were subjected to machinations somewhat similar to those applied to the old time clock, but of these the deponent sayeth nought. The business was continued until February, 1899. In August

of the same year the stock on hand was disposed of to the trade and the machinery was placed in charge of Bowler & Reid, second-hand machinery dealers, who sold it by piece meal. The business proved a losing venture throughout; and Mr. Hanna declared that his share of the loss amounted to over \$40,000, but declined to state whether or not he considered his experience worth the amount that it cost him.

LAKE ERIE IRON COMPANY.

Cleveland.

In 1878, The Lake Erie Iron Company installed a bolt and nut department in connection with their car axle works, near the lake, at the foot of Oxford street, Cleveland. Their supply of iron was manufactured at their large rolling mill on Whiskey Island.

Their original equipment embraced two Chapin carriage bolt heading machines, one "Dinkey" J. Noyes Smith machine, fed with tongs, for making track bolts.

Their business has been managed with marked ability and their volume of trade has increased proportionately. The steadily increasing demands on their manufacturing resources have been promptly supplied by the introduction of the most modern machinery and additional buildings and facilities, until their present plant has taken its place among the largest and most thoroughly equipped establishments in the country. They occupy a two-story red brick building, 500 feet long by 80 feet wide and another of two stories, with a basement, which is 550 feet long by 90 feet wide. These buildings have an abundance of light on either side, and are thoroughly ventilated and supplied with a perfect system of fire protection and fire escapes.

In addition to these, they erected, in 1902, a large building for a cold forging department which is supplied with a complete outfit of the most modern machinery designed for

this class of work. No coal is used on the premises, except under the boilers, all of the furnaces being heated with fuel oil.

The power is furnished by two large William Harris-Corliss engines. Their products consist of nearly every variety of staple bolts and nuts manufactured, and they make a specialty of the heavier grade of work, such as track, bridge and bolts for structural purposes, of which they manufacture an extensive tonnage. In connection with the factory is a ten inch rolling mill, which was built in 1896 and equipped with machinery said to have been originally used at Covington, Ky. During the same year the company sold their Whiskey Island mill to the trust by whom it was entirely dismantled. February 22, 1904, their heading department was visited with a fierce blaze, destroying a large portion of the building and damaging the bolt forging machinery, which was promptly repaired and again put in motion. Although nearly 100 men were at work when the fire broke out, facilities were so perfect all escaped without injury. The estimated loss was \$1,200, fully covered by insurance.

The present officers are: W. C. Scofield, president; F. R. Scofield, vice-president and superintendent; C. W. Scofield, secretary and treasurer.

BERRY BROTHERS.

Columbus.

The germ of this enterprising and prosperous company was planted in 1881, at which time Mr. Richard Berry contracted with the Columbus Bolt Works to furnish him a machine and necessary equipment to manufacture nuts, the product of which was to be marketed by the bolt works and a percentage of the profit of the product to be applied on the purchase of the machine, on the installment plan. A Dun-

ham machine was provided for the experiment, and, probably no machine of the type ever did more faithful and productive work than this one, operated by young Berry, during the one year's continuance of the contract. Soon after, Mr. Richard Berry established the firm of Berry Brothers, associating himself with his two brothers, Michael and James Berry. A new building was erected and five new machines were installed and operated successfully under the original arrangement for about six years.

In 1888 Berry Brothers erected the large new two-story factory building 200 x 60 feet on the line of the "Big Four" Railroad, which they equipped throughout with the most modern machinery and which they still occupy. The introduction of their product met a generous demand in the market and their business has been uninterruptedly prosperous and progressive. They manufacture a large variety of bolts, making a specialty, however, of stove and tire bolts.

The Berry Brothers are natives of Cleveland, where they mastered the art of bolt and nut making while employed by The Lamson-Sessions Co. This brief sketch of their business success testifies that the results of their training have been profitably employed. It should be added that these three industrious brothers, after buying sample machines to work from, built nearly all of the original machinery in their extensive factory, with their own hands.

THE CLEVELAND CHAPLET MANUFACTURING CO. Cleveland.

In 1886, Mr. August M. McGee invented a new and valuable method of making stove scrapers and molder's chaplets, thereby introducing an auxiliary branch of the bolt and nut industry. Forming a co-partnership with Mr. Frederick Hohlfelder, they established the Cleveland Chaplet Company,

and began manufacturing the devices at a factory on Columbus Street. A few years later, a large factory was erected at the foot of Alger Street, on the Lake Shore, to which the works were removed and largely increased by the addition of new and improved machinery. The company has been very prosperous and is doing a steadily increasing business at the present time.

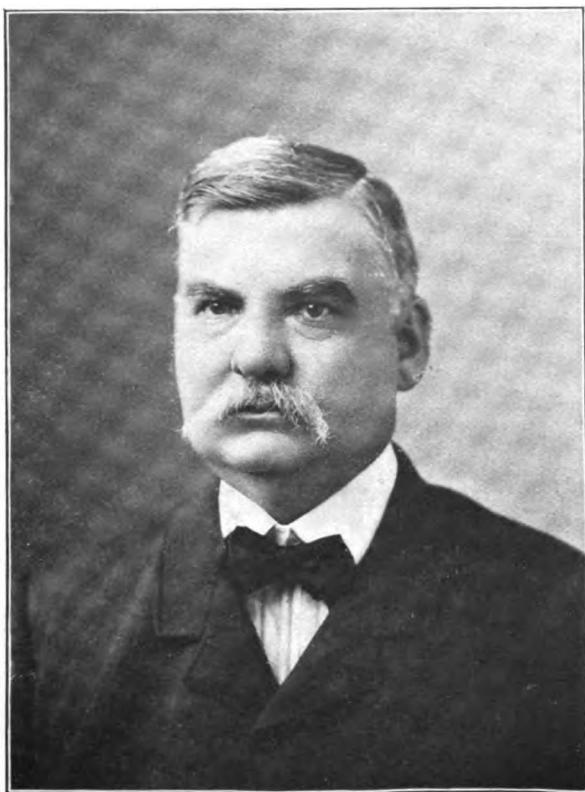
WILLIAM R. WILBUR.

William R. Wilbur was born in Norwich, Conn., April 9, 1849. He enjoyed the usual school advantages until twelve years of age, when he secured employment in the bolt and nut factory of William J. Clark & Co., Milldale, Conn. He served for a time as washer stringer, at a salary of twenty-five cents per day, but soon earned promotion, which resulted in his mastering the trade of bolt and nut making and also enabled him to acquire a thorough mechanical knowledge and to become an expert, both as an operator and constructor of the complicated machinery used in this branch of industry. In later years, Mr. Wilbur was the inventor of several practical devices that have shared in the development of modern bolt and nut machinery.

In 1869, Mr. Wilbur was married to Miss Emily Gaines, and he removed to Cleveland, Ohio, in the following year. A few years later, he accepted a position with The Lamson & Sessions Co., where he remained until 1879, when he removed to Toronto, Canada, assuming charge of the Dominion Bolt Company's carriage bolt department.

In 1884, Mr. Wilbur returned to Cleveland and re-entered the employment of The Lamson-Sessions Co., in a responsible position which he still occupies.

During 1875, Mr. Wilbur was engaged by William J. Clark in the interest of the Clark Bolt Combination to collect testimony and serve as an expert witness in suits, brought



W.R.Wilbur

for the infringements of patent rights, against Lewis, Oliver & Phillips and F. M. Haslett & Co., of Pittsburgh and Allegheny. His services resulted in a complete justification of Mr. Clark's claims.

In 1889, Mr. Wilbur was chosen to represent the bolt and nut makers of the United States, on the American Workingmen's expedition to the Paris Exposition, planned and conducted by the Scripps league of newspapers. While prosecuting this important mission, Mr. Wilbur visited the great industrial centers of Europe, where he was privileged to inspect the large establishments engaged in the various departments of mechanical industry and to acquaint himself with many details which he incorporated in an elaborate report of his journeyings and investigations, and which has been highly valued by American manufacturers and workingmen.

Mr. Wilbur was twice elected as member of the Board of Education of Cleveland, serving from 1886 to 1891, and he was thrice chosen as member of the board of the Cleveland Manual Training School. He was instrumental in introducing the manual training department in the public schools of Cleveland, and also in establishing free night schools in mechanical drawing courses for the benefit of the laboring classes.

Since removing to Lakewood, Ohio, a pretty western suburb of Cleveland, where he now resides, Mr. Wilbur has served as member of the board of trustees, and during his term of office he had charge of planning and installing the electric lighting plant which supplies both the public and private demands of the village in the most satisfactory manner.

Throughout his busy life, Mr. Wilbur has made a practice of preserving historical facts and items of interest connected with the bolt and nut industry, and the volume of information that he has collected from time to time has contributed in no small measure to the completion of the History of the Bolt and Nut Industry of America.

THE NATIONAL TACK & SCREW COMPANY.
Cleveland.

The National Tack & Screw Co., of Cleveland, Ohio, was established in 1889 by W. D. B. Alexander, O. M. Stafford, Dallas Elliott, J. K. Brainard, David C. Gries and George Gglein. They occupy a large four-story brick building situated on Stanton and Judson Streets and the Cleveland and Pittsburgh Railroad tracks. Without a question this is one of the most perfectly equipped and systematically and neatly arranged bolt and nut factories in the country. The machinery throughout is arranged with a precision that insures order and convenience; the power is transmitted by a clutch system, which almost wholly dispenses with overhead belting; and the various devices for economizing in power and labor fulfill their functions with unfailing accuracy.

The company operates forty heading machines of various types, among which are four "wish-bones." Their other machines and tools are of the most approved and practical construction for the purposes required. The products of the factory are chiefly woodscrews, tacks, small nails, rivets, tire and stove bolts, and machine, square neck and corrugated neck or "North" patent bolts. In order to keep pace with the orders the factory is kept running both night and day throughout the busier seasons of each year. The officers are: W. D. B. Alexander, president; Dallas Elliott, vice-president and general superintendent; Daniel Auld, Jr., treasurer; C. W. Brainard, secretary; Thos. Ferry, superintendent.

THE KIRK & LATTY MANUFACTURING COMPANY.
Cleveland.

The bolt and nut factory of The Kirk & Latty Manufacturing Co. was built and equipped on Malcolm Street and the

Nickel Plate Railroad, Cleveland, in 1896. The cold process system was exclusively used, employing five heading machines of the Waterbury variety, which were operated entirely automatically. The business of the company has steadily advanced, demanding additional buildings and machinery, till they now have twenty or more headers in operation and their other automatic equipment has been correspondingly increased.

A mechanical feature of the works that is worthy of special note is their manner of making nuts, which is done by passing the rods or bars, from which they are to be cut, through a pair of rolls, one of which is provided with perfect crowning or chamfering impressions or recesses, which spaces and forms the crown or chamfer for each nut on the bar or rod, which then only requires the hole to be punched and the blank cut off to produce a complete cold punch, chamfered nut. The latter work is performed automatically by presses, the lower feed roll being provided with duplicate impressions of those made by the roller process on the bar, and the ratchet feed having the requisite number of notches to correspond with the number of impressions in the roll, and so arranged that, when the bar is fed into the machine, each impression on the bar exactly fits into the duplicate on the feed roll, thus insuring accurate feed and central punching of the hole. As the relation of ratchet to the lower feed roll is provided with a sensitive adjustment device for perfectly controlling the feed, no gauge is required. This device is considered a great saver of time and labor. Nuts can be cheaply made, and up to one-fourth inch, bolt size, they can be produced at the rate of 150 per minute. There is also an item of saving in scrap iron. The roller process stretches or elongates twelve foot bars from three to four inches, which, in one-fourth inch nuts, bolt size, yields from six to eight nuts on each bar, which would go to waste by any other known cold process. This saving may

seem small, but in the aggregate, it amounts to considerable in course of a year, from a practical manufacturer's point of view.

Aside from their bolt and nut business, this company manufactures rivets, tacks, children's wagons, velocipedes, wheelbarrows, etc.

The officers of the company are: F. M. Kirk, president; S. D. Latty, secretary and business manager; H. T. Latty, vice president and superintendent.

THE CLEVELAND BOLT MANUFACTURING CO. *Cleveland.*

This company, which is closely connected with the National Screw & Tack Co. of Cleveland, O., was organized May 1, 1896, with the principal object of manufacturing and introducing the "North Patent Bolt," patented jointly by William C. North and Samuel W. Sessions of Cleveland, May 9, 1894. The principle on which the patent rights were granted was a corrugated neck, the practical superiority of which had been thoroughly demonstrated, and has since been attested by the favor it holds in the general market. The capital stock of the company was \$30,000 and the officers were: W. D. B. Alexander, president; Dallas Elliott, vice president; O. S. Wentz, secretary, and William C. North, treasurer and general manager.

In June, 1900, the capital stock was increased to \$120,000. Subsequently Mr. North sold his stock and withdrew from the company, still retaining an interest in the patents, however, which are used by The Lamson-Sessions Company and the Cleveland Bolt & Manufacturing Company. Since severing his connection with the above company, Mr. North has become associated with Mr. Thomas Ferry, the inventor and patentee of a valuable automatic nut tapping machine, and

the firm of North & Ferry Manufacturing Company has headquarters in the Caxton Building, Huron Street, Cleveland, O.

ATLAS BOLT & SCREW COMPANY.
Cleveland.

This company was organized in 1898, and located their factory and office on Marquette Street, opposite Hamilton Street, Cleveland, Ohio. They began manufacturing bolts and nuts in a small way, but have gradually increased their business and machinery, until they are now operating ten automatic heading machines and auxiliary machinery in proportion. They manufacture bolts, nuts, screws, rivets and washers, employing the cold forging process exclusively.

The officers of the company are: H. D. Marble, president; T. M. Warner, vice-president; C. R. Harbaugh, secretary and treasurer.

THE COLD-JESS COMPANY.
Cleveland.

During the winter of 1903-4, Gustav C. F. Cold and Arthur and Robert Jess, former employees of The Kirk-Latty Manufacturing Company, started a small bolt factory at No. 624 West Madison Avenue, Cleveland, under the style of The Cold-Jess Company. They built five automatic cold headers, and made a specialty of manufacturing small bolts. The following year their works were sold to the Standard Foundry Company of Cleveland.

STANDARD BOLT AND MANUFACTURING CO.
Alliance.

The Standard Bolt & Manufacturing Company of Alliance, O., was organized during the summer of 1902. They occupy

a new and well constructed brick building, located about two miles from the city, amid a wealth of orchard scenery, for it is virtually surrounded by large apple orchards. Being near the railroad, however, the shipping facilities are ample. The factory is well arranged and supplied with modern machinery chiefly made by The Acme Machine Company and The Ajax Manufacturing Company of Cleveland. Steam power is used to run their machinery, and the contrivance employed to secure their supply of water is both crude and unique. The water, which is strongly impregnated with sulphur, is taken from a well 250 feet in depth, and is elevated to a huge storage tank, from whence it is drawn as needed, to supply the factory and for fire protection. The device used for conveying the water to the tank consists of a walking beam pump, constructed of heavy timbers and provided with an automatic shut-off. The specialties manufactured are bolts, nuts, rivets and small forgings of various kinds.

The officers of the company are: W. R. Fogg, president; P. M. Haas, vice-president; E. E. Stanton, secretary and treasurer.

THE RAY AUTOMATIC BOLT & NUT COMPANY.

Berea.

The Ray Automatic Bolt & Nut Company, whose factory is located in Berea, Ohio, was organized in Cleveland in 1903. They operate automatic machinery, patented by Mr. Ray, the senior partner, and manufacture the smaller sizes of bolts and nuts.

SECTION IV.

NEW YORK.

FOX & OUTHOUT. New York City.

The first to embark in the bolt business in New York City was an English blacksmith named Henry Fox, who managed a small shop on Water Street in 1839, and established a very limited trade among wagon makers in the neighborhood. In 1843, Fox formed a co-partnership with Henry Outhout, an iron merchant, and the firm of Fox & Outhout built a factory on Twelfth Street, where they conducted a fairly prosperous business until 1853, when their business was seriously affected by the panic. They continued, however, until 1856, when a dissolution occurred, which resulted in closing the establishment and the sale of the equipment to different parties. This company manufactured bolts entirely by hand. After closing his affairs in New York, Mr. Fox removed to Paterson, N. J., where he established a factory and again manufactured bolts and nuts. A few years later Mr. Fox sold his business to The Rogers Locomotive Works of Paterson.

SAMUEL HALL'S SONS.
New York City.

In the year 1850, Mr. Samuel Hall, a chain and nail maker, who had run his factory since 1839, inaugurated the bolt industry in a large brick building on West Tenth and Bleecker Streets. After conducting the business for a few years, with not entirely satisfactory results, he became associated with Mr. Edward Page and adopted the style of Hall & Page.

In 1858 this firm obtained a patent on a device for making hot forged nuts, which promised to become very valuable. The claim to the patent was contested in the courts by Russell, Burdsall and Ward of Portchester, N. Y., who claimed that it was an infringement, and won the case. Hall & Page continued in the business, however, until 1860, when Page sold out to Hall. The company is now Samuel Hall's Son Co., which is doing a successful business.

In 1873, Mr. Charles Hall, of this company, invented and patented a machine for forging square head bolts, which introduced an entirely original principle for operating the hammers by alternating cams and recesses, formed in the inner circle of a flange of a rotating disc.

BENJAMIN BRADLEY.
New York City.

In 1856, Mr. Benjamin Bradley purchased a portion of the tools of Fox & Outhout and opened a bolt factory near the Novelty Works, Avenue C, where he made square-head machine bolts, bridge and boiler rivets. He entered the field with apparently brilliant prospects, but the history of his undertaking resembled that of the three wise men of Gotham who went to sea in a bowl—"If the bowl had been stronger, the

song would be longer." Mr. Bradley transferred his business to Mr. William Sharp, who died soon after.

GREENLIE, WYATT & COMPANY.
New York City.

In 1856, R. S. Place, a shipsmith, at 499 Water Street, bought the bulk of the tools of Fox & Outhout, and embarked in the manufacture of bolts and nuts, doing a very satisfactory business until some little time after the close of the war, when the disarrangement of prices and uncertainties connected with the period, occasioned his suspension. He held possession of his property, nevertheless, until 1879, struggling in the meantime to adjust his affairs and continue business. He was unsuccessful, however, and his entire effects were sold under a foreclosure to William Gaskell, who formed a co-partnership with William P. Greenlie, under the style of Gaskell & Greenlie. This firm conducted the business until 1890, when Mr. Gaskell disposed of his interest to his partner and retired.

Immediately after the retirement of Mr. Gaskell, Mr. Greenlie associated himself with Robert Wyatt & Co., and the firm of Greenlie, Wyatt & Co. was established. This company is still doing business and has a good standing in the industrial world.

EMERSON & DEWHURST.
New York City.

During the year 1858, Andrew Emerson & Richard Dewhurst opened a large works on the corner of Eleventh Street and Avenue D. They had a fairly successful business for nearly twelve years, but finally suspended operations entirely and disposed of their plant.

RYDER & COMPANY.**Mott Haven.**

In 1859, Mr. Joseph Yates, an extensive iron manufacturer, added a fully equipped and admirably appointed bolt department to his immense smelting works at Morrisania, N. Y., on the Hudson River, a few miles above the city. He adopted the Philadelphia method of manufacture, and the ablest workmen were employed. The enterprise proved unprofitable, and in 1862 the machinery was sold to Ryder & Co., hardware merchants, who also owned a large rolling mill with a bolt and nut department, similar to that of Mr. Yates, at Mott Haven, near the Harlem bridge, to which the entire bolt equipment was removed and placed in service. This firm now proceeded to manufacture bolts and nuts on an enlarged scale, using iron of their own production, but their output proved to be of such an inferior quality that they could not successfully compete with the Philadelphia and other manufacturers who used Norway and other better grades of iron, and after a brief experience in the business they followed in the course of their predecessors and promptly suspended operations. The works were subsequently converted into a large steel manufactory and the tools and equipment were sold, at a great sacrifice, to purchasers in various sections of the country.

THE EAST RIVER SCREW BOLT WORKS.**New York City.**

In 1865, William Gaskell, Thomas Rylance and Joseph Hitz organized the East River Bolt Works, with what Mr. Gaskell describes as "a good mechanical combination," he being a blacksmith, Rylance a practical bolt maker, and Hitz a handy man or Jack of all trades. In 1873, Mr. Hitz retired and the style of the firm was changed to Rylance &

Gaskell. In 1882 Mr. Gaskell purchased the interest of Mr. Rylance, and organized the firm of William Gaskell & Son, taking his son as a partner in the business. This firm is still doing a successful business at 433 East Twenty-fifth Street, and their factory is known as The East River Screw Bolt Works.

JAMES McMANNUS.
New York City.

In 1866, Jarvis & Co. opened a small bolt and nut factory on Christopher Street, near the North River, employing a battery of five Olivers and producing about 6,000 bolts per day. They continued until 1872, when they sold out to James McMannus, who was burned out, sustaining almost a total loss, in 1874. With what machinery he had saved, he removed to Brooklyn, where he began manufacturing gasometer and stack rivets. Hitherto this class of rivets had been made exclusively by hand and had never been placed on the market as a merchantable commodity. Mr. McMannus is entitled to the credit of originating an entirely new branch of the business by making his rivets by machinery, using his Olivers for the purpose, and by introducing them to the general market. After McMannus had made this important achievement, and had built up a small but promising sale for his goods, a number of larger manufacturers, appreciating the value of the process, entered the field and became such lively competitors that he was soon compelled to retire from the business and sacrifice the profits of his ingenuity to others. 'Twas ever thus in manufacturing as well as in other lines — "the big fish are wont to devour the little ones."

WILLIAM GASKELL.

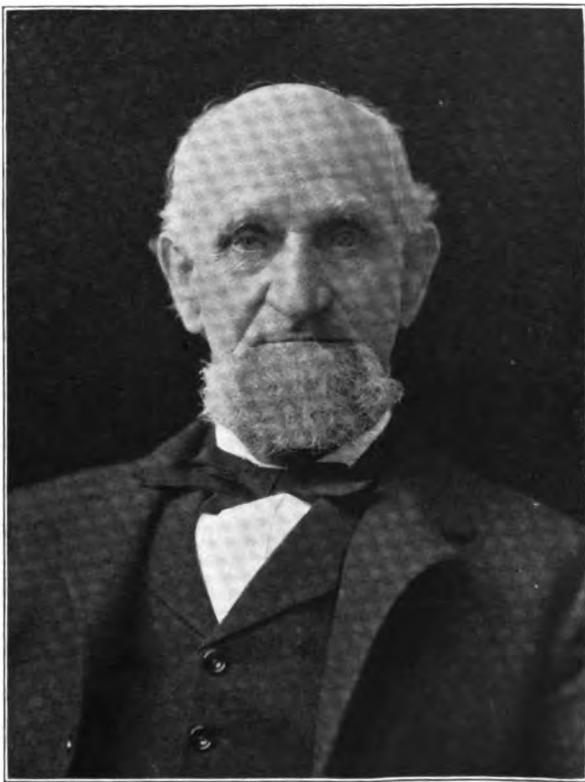
Mr. William Gaskell is the oldest bolt and nut maker living in New York City, where he is still actively and successfully engaged in the business.

Mr. Gaskell was born in Lancashire, England, January 27, 1833. He began learning his trade in 1845, serving as a bolt helper on dolly swages and fly presses, and afterwards served an apprenticeship of three years at general blacksmithing.

In 1857, Mr. Gaskell came to America and began working at his trade in New York City, where he succeeded in establishing himself in business by forming a co-partnership with Thomas Rylance and Joseph Hitz and organizing The East River Bolt Works, now known as The East River Screw Bolt Works, and owned and managed by himself and son, under the style of William Gaskell & Son.

In 1882, William Gaskell & Son purchased the factory established by Damon Schweiser and others, at Green Point, Long Island, and equipped it for ship and heavy forging. The factory has proved highly successful, and is doing an extensive business.

During Mr. Gaskell's long business career, New York City has been the scene of many disastrous failures in the line of industry in which he has been engaged. The metropolis of America, with its matchless facilities for reaching all markets, naturally afforded an inviting field for manufacturers, and among those entering it were a large number of bolt and nut manufacturers who apparently prospered for a time, but eventually met with disaster. Contemporaneous with these, Mr. Gaskell, guided by conservatism and yielding to no wild



Wm. Garfield

speculative allurements, pursued the even tenor of his way and achieved success in all of his varied undertakings. At the present time Mr. Gaskell has entire charge of the management of the East Twenty-fifth Street factory, while his son, the junior member of the firm, conducts the Green Point factory.

WILLIAM GASKELL & SON.
New York City.

In 1869, Damon Schweizer began making bolts at Green Point, Brooklyn, by professing to have valuable patents on a bolt and bolt machinery. Schweizer induced a wealthy Baltimore dry goods merchant to invest \$126,000 in his enterprise, and when the factory was completed at Green Point, he suddenly disappeared, leaving the dry goods merchant the entire factory and such experience as he had gained in return for his heavy investment. The injured party made several attempts to realize on his investment, but each failed in turn until 1882, when William Gaskell & Son made a cash offer of \$2,600 for the entire outfit and became its purchasers. This firm destroyed a large portion of useless machinery, replacing it with practical bolt machinery and an outfit for doing general blacksmithing on a large scale. These works are doing a prosperous business at 50 to 61 West and Freeman Street under the supervision of the younger Mr. Gaskell, while Mr. Gaskell, Sr., has charge of the East Twenty-fifth Street factory.

The records of New York City furnish the names of various other firms who have from time to time engaged in the bolt and nut business. But after thoroughly sifting them down, they appear to have existed on paper in name only, or as trafficking in the product of other manufacturers.

RUSSELL, BURDSALL & WARD BOLT AND NUT CO.
Portchester.

Ellwood Burdsall and William E. Ward became acquainted in the city of New York during the winter of 1844. William E. Ward was an expert mechanic and was working as a journeyman at the Novelty Works, and later for a man by the name of Moore, who was making a machine for forming the heads on iron rods for screws. Ellwood Burdsall was working as a clerk for Hickok & Co., who operated a stove foundry. Mr. Ward became impressed with the idea that he could devise machines for the manufacture of screws more economically than had previously been done, and October 1, 1845, a partnership was formed between himself and Mr. Burdsall for the manufacture of screws, the name adopted being Burdsall & Ward. Mr. Burdsall continued in his position as book-keeper under a salary of \$600, which he divided with Mr. Ward, and which provided the funds with which they started the business. Russell, Mackay & Beach were at that time operating a button factory at a place called Russellville, subsequently Pemberwick, Fairfield County, Conn., near Portchester, N. Y. At this place there was quite a fall in the Byram River, affording a good water power. Arrangements were made with this company for the rental of a room with power, and a lathe was put in and Mr. Ward started to build his machinery. The first header devised by him had four dies in a roulette. The blank was fed into one die, then the roulette was turned one-quarter revolution, and the blank was headed and the roulette was turned another quarter revolution and the finished blank was discharged. This latter operation gave some trouble and the machine was not entirely successful. There were also built one nicking machine, two shaving machines, and four threaders, and they started under the name of The Union Screw Company, to manufacture wood screws.

Just at this time the New England Screw Company obtained a patent on the gimlet-pointed wood screw, which was so superior to the unpointed screws manufactured by Russell & Ward that the manufacture of screws was abandoned. It was then suggested to Mr. Burdsall by Thomas Southard, a stove manufacturer of New York City, that if the screws as made by them were fitted with nuts they would answer for putting stoves together, and also, the advisability of making stove rods.

The year 1847 was an unusually dry one and there was not sufficient power at all times to meet the requirements of both parties, and in order to overcome this difficulty, as well as to obtain additional funds, one-third interest in the business was sold to Russell, Mackay and Beach, and the name was changed to Russell, Burdsall & Co. By the agreement entered into at this time, Edmund Beach was to devote all his time not taken by the button business to the interests of the screw company, and Ellwood Burdsall and William E. Ward were to devote all of their time to the business. Mr. Burdsall took some samples of stove bolts to Albany and obtained some very good orders. They also sold a good many bolts in New York City and in Stamford. The iron at this time was purchased from a mill about eight miles distant from their works, and was hauled with one horse, and the finished bolts were hauled to the boat at Portchester by the same horse.

In July, 1850, Mr. Ward obtained a patent (No. 7538) on an open die header, wherein the rod was fed into the machine, gripped between two dies, while the upsetting punch advanced and formed the head, then the upsetting punch retreated and was elevated and the rod was fed through under it against a stop, when the upsetting punch descended, cutting the finished blank off. This header was used for making carriage and plow bolts. Some of these bolts were made of square iron, in which case the header was set over a pit and a boy would pick them up with tongs while hot, and swage the barrels. Carriage bolts were made out of round iron and the

square under the head upset into the dies. Chilled cast iron dies were used in this header. In 1851 Mr. Russell purchased the interest of both Mackay and Beach, and the name was changed to Russell, Burdsall & Ward.

In 1852 Mr. Ward obtained a patent (No. 9508) on a solid die heading machine, which overcame the difficulties met with in his roulette machine. In this machine the die was contained in a cross slide at the front of the header which was moved to three positions. In the first position the stock was fed through the die against a stop. Then the slide moving to the second position, cut off the blank with the back of the die, moving across a shear, as is the common practice now. In the second position, the stock was forced into the die against an adjustable yielding pin and the head upset, and in the third position, the blank was ejected from the die. This header was used for making plow, tire and stove bolts by upsetting the metal cold. Mr. Ward was always an advocate of a short square on carriage bolts, claiming that the only use of this square was to hold the bolt from turning while the nut was screwed up. The trade, however, demanded a long square, and to meet this they made these bolts out of square iron and drew the barrels out under a swage hot. In 1853 Mr. Ward obtained a patent (No. 38518) on a machine for automatically rolling the barrels round from square stock cold. This machine gave the company almost a monopoly on this class of carriage bolt.

In 1856 Mr. Ward obtained a patent on a machine for forging nuts. This machine was operated successfully until about 1880. In this machine the bar was fed into the machine, the holes punched, then the nut cut off; there being always two holes in the end of the bar. The nut cut off was forced onto a mandrel, where the nut was hammered square between two hammers, the nut revolving one-quarter turn between each blow. At the same time the nut was cupped or crowned.

In 1866 the company was formed into a joint stock cor-

poration, with Mr. Russell as president; Mr. Burdsall, attorney and general agent; Samuel Comly, secretary and treasurer; Mr. Ward, manager.

During the subsequent prosecution of the business, various changes and modifications were made in the machines used. A great many machines were devised for automatically finishing the bolts, some of which were eminently successful, such as automatically pointing and threading bolts, and shavers for shaving the heads of carriage bolts, and machinery for automatically tapping nuts.

In 1871 Isaac D. Russell died and William E. Ward was elected president. From 1880 to 1882 Mr. Ward was busy devising machinery for the manufacture of cold cut nuts and finishing machines for tire bolts. In 1882 he organized the Portchester Bolt & Nut Company for the manufacture of these goods. His son, William L. Ward, who had been in the mechanical and manufacturing department of Russell, Burdsall & Ward since 1877, acted as manager of the new company, and Samuel Comly, who had long been in the employ of the old company as salesman and subsequently secretary and treasurer, entered the new company as treasurer. This company was very successful and its business grew rapidly. In 1889 Ellwood Burdsall died and Richard H. Burdsall, who had been in the financial department of the company since 1877, was made treasurer. Mr. Ward's health at that time being quite feeble, Ellwood Burdsall, Jr., assumed the direction of the mechanical department of the company. He was graduated in the Mechanics Arts course of Cornell University in 1878, and since then had been directly associated with Mr. Ward in the designing of his machinery. He has since designed many machines that are in successful operation. In 1900 Mr. Ward died, and his son, William L. Ward, was made president of both companies. On April 15, 1901, Russell, Burdsall & Ward and the Portchester Bolt & Nut Company were consolidated under the name of the Russell, Burdsall

& Ward Bolt & Nut Company. It is the aim of this company not to rest on the reputation of their predecessors, but to adopt their policy of putting on the market the best goods that can be made. They point with pride to the finish of their product and of the interchangeability of their nuts, any nut fitting any bolt of like kind and diameter. It has been their aim in cheapening their product to accomplish this by advanced methods of manufacture, and not by a reduction in the quality of the goods.

Russell, Burdsall & Ward's mode of manufacture in the beginning differed very little from all other carriage bolt and nut makers at that time. The bolts were forged from heated square bars of iron mostly by hand.

It will be remembered that carriage bolts at this time (1850) were rounded or swaged but very little more than the length of the thread. It quite naturally suggested itself to the mind of William E. Ward, of Russell, Burdsall & Ward, that a large saving in iron could be made by making a short, stove-in square by heading bolts off the rod from round iron. This new idea was put into effect and quite a number of bolts were made with shorter squares. But when these bolts were offered in the market, there arose an attack on the new departure, fiercer, perhaps, and from more quarters than the makers had anticipated, but not greater than they could overcome, though the battle lasted for several years. The leading objection was that the shortness of the square would not hold in the wood sufficiently to prevent turning while screwing the nut. In order to overcome this objection and retain the trade, the square was returned to its former length, but gradually shortened, year after year, until reduced to the present length of about twice the diameter of the full-sized bolt, and about the diameter of what is known as the common bolt.

Russell, Burdsall & Ward were men of advanced ideas, ever ready to secure late improvements and to adopt ~~all~~ the better methods. They were the first to construct a bolt head-

ing machine, on which stove and tire bolts were forged cold automatically. With this machine the first stove bolts placed on the American market were manufactured. The original stove bolts introduced by the firm were neither shaved nor slotted.

Shaved and slotted stove bolts and turned head tire bolts were first offered to the trade in 1855.

In 1856 Mr. Ward completed the first forged or hammer nut machine ever invented. Although this machine made rather poorly finished nuts and did not prove a success in itself, it convinced the inventor of the practicability of the principles involved, and lead the way to the perfecting of machines that produced more than 30,000 forged nuts per day.

During the crisis of 1857, when the mills and factories of the country were generally idle for want of orders, manufacturers and mechanics were busy thinking, reflecting and inventing new methods. Russell, Burdsall & Ward matured a new and distinct process of bolt manufacture, which they immediately commenced to put into successful operation. The plan was to work the iron cold, making the bolts complete without heating except for annealing before turning the heads. A massive back geared heading machine was constructed, the original of which is described in detail and illustrated in the machinery section of this work. The cold bars of square iron were fed into the machine automatically, gripped by the holding dies, headed by the forward motion of the machine, fed underneath the upright sliding device to a gauge, cut off the desired length and dropped out into a box at the rate of about forty per minute. The next operation was to round or swage the blank, leaving the requisite length of square neck under the head. Considerable difficulty was experienced in perfecting a machine to perform this part of the work. A powerful pair of half rolls were constructed on a nearly square horizontal bed, so as to revolve towards the front. An automatic holding arrangement was

operated in such a manner as to grasp the blank by the head, carry it forward between the rolls, making one-fourth turn at each advance of four or five passes, as the size of the bolt required or the machine might be timed. The machine was fed by suspending the bolts by their heads in a long row between two curved conductors, inclined enough to allow the bolts to feed themselves down the incline around a curve to a horizontal position by their own weight. Here they were caught one at a time by spring nippers, carried into the machine, swaged and thrown out. The chief difficulties met with in operating these machines were the formation of two large fins under the head, where the holding dies came together to grip the iron while being headed by the tremendous pressure required to compress the cold stock into the desired shape of the head, the formation of short kinks in the bolts by rolling or swaging process and a shredding of the iron that occurred. The former was overcome by placing the bolts endwise through a hardened steel die, squared out to fit the desired size of bolt and placed under a suitable power press carrying a die of the required form of head, one stroke of the press being sufficient to perfect the form and compress the fins, thus leaving a smooth, even surface beneath the head for a good bearing. The latter necessitated the straightening of the blanks, which was done by a pair of flat surface dies operated by an ordinary power press. The bolt was placed across the stationary or bottom die up to the head and struck twice, once on each side of the square, leaving a slight flat impression of the dies extending down from each side of the square the full length of the round. The shredding was overcome by using an improved quality of iron. The automatic feed, described in the swaging machine was applied to the pointing and screw cutting lathes. The hand tool used for turning the heads was displaced by a set tool operated with a lever insuring a uniformity of finish and size of head. Previous to turning, the bolts were annealed in air tight retorts cemented with fire clay, by

arranging them one above the other in a furnace constructed after the style of chimneys used in farm houses fifty years ago. The bolts after being turned were immersed in a hot solution said to be composed of water, salsoda, beeswax and oil. This preserved them from rust and gave them an attractive finish.

The above describes the main features of the original cold working machines which have since been materially improved from time to time, either in part or in whole. New additional machines have been invented and new buildings erected, with proportional facilities as business required, until Russell, Burdsall & Ward became the largest full square carriage bolt manufacturers in America. The firm had a large and well equipped machine shop in which they made their own peculiar class of machinery, under the supervision of Mr. Ward, who had besides obtaining several patents, made other valuable improvements not patented, more especially useful in making goods of which they were for years the almost exclusive producers. Among these was an ingeniously contrived machine for forming the point and cutting the thread with a chasing tool, automatically feeding the blanks into jaws, which seized the end bearing the head, advancing it against a tool which formed the point, the blank then passing to a chasing tool which cut the thread as by an engine lathe, varying the number of cuts to the size and amount of metal to be removed. This machine was designed to be used principally for threading lag or coach screws. No doubt Mr. Ward's greatest achievement was the invention of his cold nut machine in 1880, on which he further improved and secured a patent December 7, 1886. This machine automatically takes the iron from the bar, punches the hole, cuts off the nuts, crowns or chamfers the top and passes it through a trimming die, making a complete, semi-finished square or hexagon nut by a single operation. These nuts are chiefly used for tire bolts. Making use of this machine the Portchester Bolt & Nut Company organized one of the largest tire bolt trades in the country.

Another remarkable feature of the Russell, Burdsall & Ward establishment is the performance of nearly all branches of labor by machinery, the labor of the hands being confined almost exclusively to the feeding of the machines. The bolt iron is taken by the ton and deposited in an enormous pickling trough, where the scale and rust is removed by the action of sulphuric acid and live steam, lifted out and immersed in a raceway of running water and conveyed to a proper place in the works by a powerful hoisting apparatus having tramways overhead arranged to travel in any direction desired.

The rod is now fed into the heading machine so as to pass between a pair of friction feed rolls operated with a ratchet, conveyed through a tube to the holding dies in the center of the machine, when, with one stroke of the header, the bolt is headed, the length accurately determined by an adjustable gauge and cut-off. These blanks so headed of square iron are taken to the swaging machine, where they are suspended by their heads in low rows, as previously described. The automatic feed of this machine reaches out and closes its mechanical fingers around the head of the blank, carrying it forward, and when finished, drops it outside, again reaching out to pick up another one to go through the same operation, giving the idea that the machine is almost possessed of reasoning powers, so careful, deliberate and intelligent seems to be its imitation of motions a workman would make in performing similar work.

The bolt blanks now pass on to the presses, where the fin under the head, formed by heading, is driven down, and from there to the straightening process, the pointing lathes and threading machines, to the annealing furnace, where any crystallization that may have taken place in the different operations is removed by the process of air-tight annealing. The bolts now go to the turning lathes, are solutionized, and pass to the nutters and pilers, where the nuts are partially screwed on by machinery. The nuts are placed in hoppers and feed

down one at a time into a suitable socket, carried on the top end of a small, rapidly revolving, perpendicular shaft, driven from beneath the bench. The bolt is taken between the thumb and fingers and the threaded end entered into the hole of the revolving nut, when the nut is whirled on like a flash, after which they are piled, papered or boxed in the ordinary manner.

Their forged nut machines are very similar to the Dunham. Stove and tire bolt nuts are made cold on Ward's machine. The tire and stove bolt blank shavers and slotters and threaders are so arranged as to guard against accidents as completely as if they were possessed of human intelligence. If any one part ceases to operate or to properly fulfill its function, the machines will stop of themselves, or have self-adjusting contrivances to remedy the difficulty. If the blanks are too long or too short they cannot be worked, and if too much strain is brought to bear on any part from any displacement of the machinery or the introduction of foreign matter, the machine stops and makes a peculiar noise readily distinguished.

The principle features of all the bolt and nut making machines have now been practically described, although from the great variety of goods made, no less from the many improvements which have been successively introduced by the firm, there are various differences in the details of the operations in swaging and finishing, nearly all the work, however, is done by machines, which work automatically, and some of the machines here for forming particular patterns of bolts are different from those in use anywhere else. In fact, Russell, Burdall & Ward were for years the only manufacturers of carriage bolts made entirely by the cold method in the world.

When cold made bolts were first offered in the market and were claimed to be superior to hot made bolts there arose the customary attack made on nearly all new methods. The leading objections put forward to cold forged bolts were that in heading and swaging the fibers of the iron were disintegrated;

that in cutting the threads on cold swaged bolts the dies frequently loosened, the broken fibers leaving an imperfect and very weak thread and finally that the cold made bolts were generally unreliable. The correctness of such statements was persistently denied by the firm as applied to their productions; on the contrary, claiming the additional increase of strength in bolts from working the metal cold at between 50 and 100 per cent., and the effect in general to give the iron a good deal of the qualities of steel. Whatever may have been the difference in opinion raised in the manufacture of cold made bolts, the success which has attended this firm in placing them before the public has silenced them all forever on that score. Wherever this firm is known their reputation as makers of superior goods is fully established and justly deserved. Their business has steadily increased and multiplied. Their success may be regarded as another example of persistent effort and concentrated energy in the methods of production combined with strict integrity in the discharge of all business obligations, not only with the trade, but with their employés, with whom they have always been on the kindest terms. It is and has been the aim of the proprietors to make the surroundings of those who live in the immediate neighborhood and who earn their living there so pleasant that there will never be cause to complain. The firm has erected a library hall building for the purpose of affording their employés better opportunities of self-culture. It consists of a well selected library of about 2,000 volumes, and the scientific portion of the books were chosen by Professor Youmans with especial reference to the needs of such a class of working readers. There is here, also, a warm and well-lighted room intended to make a comfortable place in which the employés can profitably and pleasantly pass their leisure hours. The firm of Russell, Burdsall & Ward have always stood on their own merits, never having entered into any combinations with any syndicate or trust, or affiliated with any other firm except their legitimate offspring, the Port-

chester Bolt & Nut Co., with whom they were consolidated on April 15, 1900, reincorporating under the style of Russell, Burdsall & Ward Bolt & Nut Co., with the following officers: W. L. Ward, president; Samuel Comly, vice-president; H. H. Burdsall, treasurer; W. S. Comly, general sales agent; Charles Eldredge, traffic manager; H. E. Marshall, purchasing agent.

THE PORTCHESTER BOLT & NUT COMPANY.

Portchester.

In 1882 the Portchester Bolt & Nut Company was organized with the following officers: William E. Ward, president; Samuel Comly, treasurer; W. L. Ward, general manager.

The principal products of the company were tire bolts, stove bolts and cold pressed nuts. Their business was prosperous and rapidly increased in volume and importance. At the death of Mr. W. E. Ward, president of both companies, he was succeeded by his son, W. L. Ward, as president of both corporations, and steps were taken to amalgamate the two, which was consummated as stated above. Immediately after the consolidation the new company began the erection of commodious new buildings beside the tracks of the New York, New Haven & Hartford Railroad at Portchester, thereby securing the most admirable shipping facilities and other valuable conveniences. The new buildings were made ready for occupancy late in the fall of 1901 and during the winter and spring of 1902 the work of removing their entire machinery was accomplished. A large quantity of new machinery and tools was also added to the plant, making it one of the largest and best equipped factories extant. The company has no city warehouse. The manufacturing and all other business is conducted at their model factory in Portchester, where the owners and managers reside and where they devote their entire time and energies to the extensive industry they have so successfully established.

WILLIAM EVANS WARD.

William Evans Ward was the founder of Russell, Burdsall & Ward, and also of the Portchester Bolt & Nut Co.; was born in Indiana on April 29, 1821, and died at Portchester, N. Y., March 2, 1900.

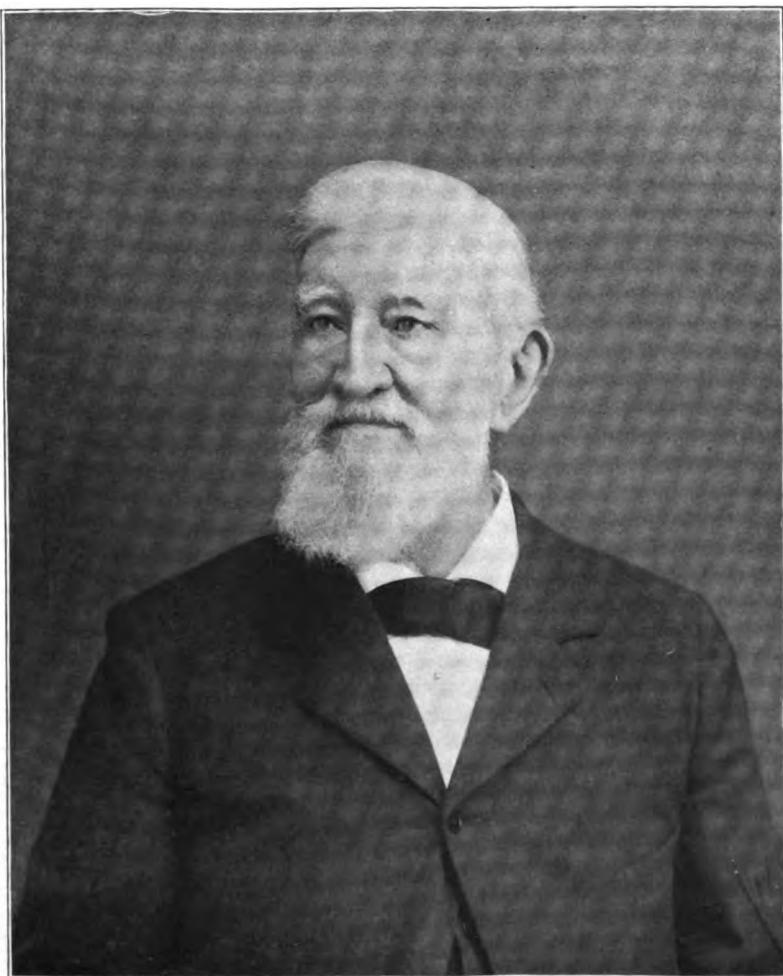
At an early age he moved to Philadelphia, where he learned the trade of machinist, pattern-maker and moulder. Mr. Ward's superior mechanical skill was supplemented by such a high order of inventive genius that he won recognition both in this country and abroad for his novel and superior inventions to which he devoted his talent. His ideas were especially notable for their indisputable originality, both in conception and construction, as well as the evidence they afforded of his complete mastery of mechanical principles and science. He never copied nor adopted the ideas of other inventors, for his active brain seemed so prolific of novel conceptions that he had no occasion to seek them elsewhere.

In 1847 Mr. Ward became the junior partner of the bolt and nut manufacturing firm of Russell, Burdsall & Ward, Portchester, N. Y. As general manager of the works, he had exclusive charge of the mechanical department, the duties of which kept his active and inventive mind constantly in operation.

Mr. Ward invented and constructed automatic machinery for making carriage, plow, stove and tire bolts. He was the originator and founder of cold process in making bolts, and introduced an entirely new and distinct method, which enabled the enterprising firm to virtually control the market on high class bolts for a number of years.

Mr. Ward invented the first hot forged nut machine ever placed in operation. He was one of the original inventors of the gimlet pointed wood screw machine, which patent he sold to the American Screw Company for a small sum.

In 1858 he invented and built a steam plow, which was a



W.E. Ward

marvel for the times and has not been improved on even at this late day. He was one of the first inventors to bring out a lawn mower, which he simply kept for his own use, and never paid any attention to putting the same on the market. He also invented a most ingenious machine for making metal shutters. All of these inventions were gotten out and made to work practically prior to 1861.

In addition to performing his duties in the mechanical department, Mr. Ward also applied himself most carefully to the business of the firm, and made his services so valuable in this direction that he was elected president of the company on the death of Mr. Russell in 1871.

In 1882 Mr. Ward, together with Samuel Comly, and his son, William L. Ward, organized the Portchester Bolt & Nut Co., of which Mr. Ward was made the president. This company made an exclusive specialty of manufacturing tire bolts and cold pressed nuts, and continued in business until 1901. On April 15, 1901, the two corporations, Russell, Burdsall & Ward and the Portchester Bolt & Nut Co. were consolidated under the name of "Russell, Burdsall & Ward Bolt & Nut Co." with Mr. W. L. Ward as president.

In conclusion, it may be justly said that among the many gifted inventors who have shared in devising improved machinery and methods, Mr. Ward occupied a place on the line, and was a most cultured and delightful man to meet.

He was a charter member of the American Society of Mechanical Engineers; he was a charter member of the Engineers' Society; he was a member of the American Society for Advancement of Science; was an original thinker and worker in scientific investigation; a student; one who represented, in the highest degree, the best that there is in American manhood.

Mr. Ward's reading and study had been so varied that there was hardly a subject that he was not a master in — art, music, poetry and science — and when he passed away, none who knew him but could say that the world was much better for his having lived in it.

ROY & CO.**Troy.**

In 1850 Roy & Co. began the manufacture of cold punched nuts and washers. Of this company very little is known further than they were reputed to be a very strong concern, and placed the larger sizes of nuts on the market, running up to $3 \times 3 \times 1\frac{1}{2}$ inches. Their output, however, was said to be of a rough finish and did not cut much of a figure in competition with other makers. It appears that their chief business was the manufacture of wearing fabrics, ladies' shawls, etc., and their nut and washer venture was abandoned about 1860.

BELL & MARCELLUS.**Amsterdam.**

In 1855 Mr. George C. Bell opened a small carriage bolt factory in Amsterdam, in which Messrs. James P. and Aaron Marcellus soon afterwards became partners under the style of Bell & Marcellus. In 1863, Messrs. Bell and James P. Marcellus withdrew from the firm and jointly established a bolt and nut factory in Buffalo, N. Y. Mr. Aaron Marcellus formed a co-partnership with Mr. H. M. Green, formerly of Unionville, Conn. This firm conducted the factory in Amsterdam for a short time, when it was finally closed, Mr. Green embarking in the livery business and Mr. Marcellus going to Rockford, Ill., where he became interested in the Rockford Bolt Works in 1871, with which he continued until his death, which occurred a few years later.

The firm of Bell & Marcellus in Buffalo continued in business but a short time, when Mr. Marcellus transferred his interest to Mr. Sherwood and removed to Syracuse, where he founded the Syracuse Bolt Company, with which he was identified until he died, a few years later.

SARATOGA BOLT COMPANY.**Saratoga.**

In 1855 or '56 a company known as the Saratoga Bolt Company was organized. It appears this company secured the most improved machinery of the time, and that they erected a well appointed factory building. In providing a water supply for factory purposes, the famous Geyser Spring was discovered in their forging department, and the bolt business was abandoned. In fact but little of the machinery was put in service, but was eventually sold, mostly to the Plant Manufacturing Co.

THE BUFFALO BOLT COMPANY.**Buffalo.**

The business to which this prosperous company succeeded was established in Amsterdam, N. Y., by George C. Bell, in the year 1855. Subsequently Mr. Bell formed a co-partnership with Mr. James P. Marcellus, and, under the style of Bell & Marcellus, they removed to Buffalo, N. Y., in 1863. Later on Mr. Marcellus sold his interest to Mr. Sherwood, and the style of Bell & Sherwood was adopted. In 1868 Mr. Ralph H. Plumb purchased Mr. Sherwood's interest, and the firm became Bell & Plumb. Up to this time the factory had made a specialty of square iron carriage bolts, with turned and polished heads, but they now added to their list pinched-neck bolts of all diameters, up to one-half inch.

About a year later, Mr. Orrin C. Burdick became a member of the firm, a circumstance that proved highly advantageous. Mr. Burdick was called a nutmeg Yankee, and he proved that he was as familiar with the construction of iron bolts and nuts as he was with wooden nutmegs. He was a man of genius, a skilled mechanic and he became the inventor and builder of many practical machines. The firm soon be-

gan manufacturing bolts of all sizes up to one inch in diameter. Mr. Burdick fairly revolutionized the machinery, improving old, inventing and building new, among others his famous "Advance" square head bolt forging machine, which has never met a rival; his steady motion heading machine and others that have rewarded him with fame and fortune. In his "Advance" header Mr. Burdick made a marked improvement on his square head forging machine by which the holding dies were made to grip the bolt blank in carrying it forward, holding it while the hammers forged the head, then receding and delivering a finished bolt automatically, and increased the output from one to two thousand per day over any other similar machine in use.

After Mr. Burdick had been connected with the firm two years he and Mr. Plumb purchased the interest of Mr. Bell, and the style was changed to Plumb & Burdick. In 1873 Mr. Barnard became a partner in the business and the name of the firm was changed to Plumb, Burdick & Barnard. After perfecting his Advance header, Mr. Burdick was slow in appreciating its true value. A number of machines were placed on the market and found a ready sale. As soon as the superiority of the machine became recognized, however, the company, which controlled the entire rights, decided to discontinue the sale of machines and by this means they succeeded in virtually controlling the entire market for square head machine bolts, until the patent rights expired in 1893. During this period, many other firms had endeavored, but to little purpose, to compete for this trade. The market had been flooded with inferior bolts; machines were built to compete with the Advance, that made a good quality of bolts, but they could not begin to equal the speed of the several Burdick machines. When the Burdick patents finally expired there was quite a host of competitors who were anxious to take advantage of the event, and the competition, with other complications, became so powerful that it ultimately resulted in forc-

ing Plumb, Burdick & Barnard into financial difficulties that resulted in their suspension, which occurred in 1897.

When the original company, Bell & Marcellus, later Bell & Plumb, and still later, Plumb, Burdick & Barnard, located in Buffalo, they occupied a small two-story brick building on the corner of Clinton and Adams Streets, near the N. Y. C. & H. R. R. R. tracks. Up to the time that Mr. Burdick became a partner with Bell & Plumb, their equipment enabled them to produce a daily average of 15,000 carriage bolts. After Mr. Burdick became a member of the firm of Bell, Plumb & Burdick, they increased their plant and machinery from time to time until their buildings extended to Eagle Street, which enabled them to increase their daily output to 350,000, mostly machine and carriage bolts. In the meantime, Mr. Burdick invented and patented a diamond neck carriage bolt which the firm introduced to the trade and which commanded an extensive sale, especially with the manufacturers of agricultural machinery, but their popularity continued but a few years.

Soon after the failure of the firm, Mr. R. H. Plumb, the senior partner, perfected the organization of the present Buffalo Bolt Co., with the following officers and board of directors: Ralph H. Plumb, president, and Robert C. Board, treasurer; directors, Robert C. Board, John J. Albright, Edmund Hayes, Herbert H. Hewett and R. H. Plumb.

The machinery was at once removed to a large and admirably appointed factory building at North Tonawanda, N. Y., near Buffalo. Steam power was used for a few years, but the entire machinery of the factory is now harnessed to the electric power furnished by the Falls of Niagara. The daily output of this model factory is over half a million finished staple bolts and nuts of every size and variety. The remarkable success of this widely known company is entirely due to the business tact and energetic management of President Plumb and his staff of able assistants.

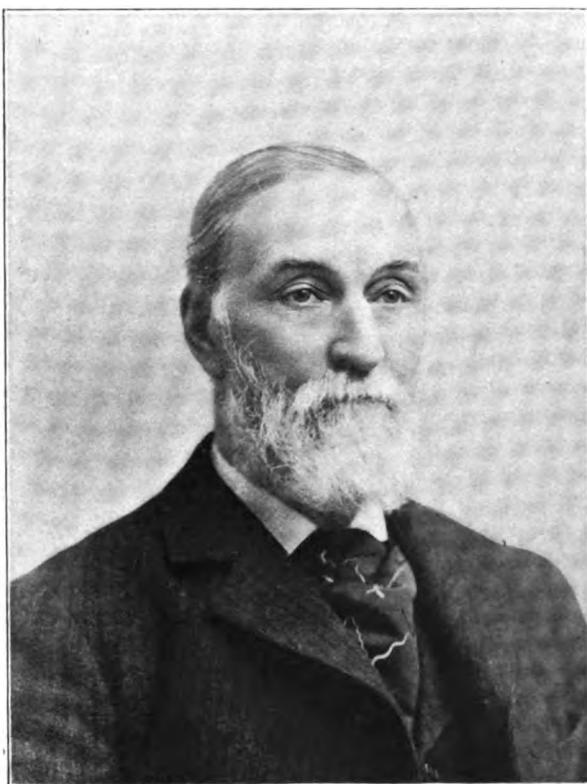
ORRIN C. BURDICT.

Mr. Orrin C. Burdick, of Buffalo, N. Y., not only stands prominent among the pioneer bolt and nut manufacturers of America, but his ingenuity and mechanical skill have richly contributed to many of the improvements in the machinery and appliances used in this important branch of industry.

In the year 1860 Mr. Burdick began working for Mr. Chandler Cowles, who was making bolts by hand in New Haven, Conn. The work so strongly appealed to Mr. Burdick's inventive genius, that he devoted a large share of his time to devising improved appliances and methods that he believed would greatly facilitate the various processes. Following his own ideas, he had constructed models and made drawings when the opening of the war of the rebellion aroused his patriotism and he enlisted as a private in the 27th Regiment of Connecticut volunteers. At the expiration of his term of service, July 22, 1863, Mr. Burdick resumed his position with Mr. Cowles, and proceeded with renewed energy to perfect his machine for making bolts and nuts, which he accomplished before the end of the year, having secured a patent and built a perfect nut machine before December 31. Mr. Burdick sold the entire rights in this patent to the Lindsay Fire Arms Co. of New Haven, who manufactured them for the trade, and for several years he traveled for the company, selling the machine that he had invented.

In 1865-66 Mr. Burdick brought out his first bolt head forging machine, which was also assembled by the Lindsay Fire Arms Co. It was tested on 1 inch bolts and seemed to work to perfection; but it developed defects that rendered it a failure at the beginning.

In 1867 Mr. Burdick removed to Providence, R. I., where he contracted with Mr. Gardner of The Providence Steam Engine Co., to build the machine on new lines that would overcome the imperfections. Assisted by an expert me-



O. C. Benedict

chanical engineer, Mr. Burdick brought his invention to such perfection that he sold them the right to manufacture the machines to the United States government, reserving all other rights. A number of the machines were sold to the government as were also his nut machines. The arrangement with the Providence company continued until Mr. Burdick removed to Buffalo, N. Y., in 1869, where he sold his rights to Messrs. Bell & Plumb of that city, accepting stock in part payment, thus becoming a member of the firm, the style of which was changed to Plumb, Burdick & Barnard. The manufacture of the machines was continued in Providence a number of years, Mr. Burdick having control of their manufacture and sale. During this period Mr. Burdick made several specific improvements on the original construction, among which was a time attachment, by which the machine was automatically stopped after the requisite number of blows to complete the forgings, and an advance attachment, which gripped the bolts, carried them forward, completed the forging and delivered the work completed, automatically. This device was designed especially for the smaller sizes of bolts. Mr. Burdick also invented steady motion carriage bolt forging machines, which were afterwards improved for rod headers. This improvement rendered them the most rapid rod heading machines ever placed on the market.

Mr. Burdick's first invention, the square head bolt forging machine, was the first successful machine of the kind ever manufactured. It was also the first to be introduced to the American and foreign markets. The value and practicability of these admirable machines were promptly recognized and they were sold in large numbers in every section of the world.

In 1897 the firm of Plumb, Burdick & Barnard became financially embarrassed and were obliged to retire from business. After the affairs of the company were adjusted, Mr. Burdick established a business by himself, locating his office in the White Building on Main Street, and making a specialty

of various kinds of bolt and nut machinery of his own invention and construction. Since inaugurating this enterprise Mr. Burdick has enjoyed deserved and uninterrupted success. Mr. Burdick was born in Burlington, Conn., April 19, 1822. He was a natural mechanic and inherited Yankee ingenuity which he energetically cultivated and has always successfully employed to notable advantage.

THE CENTRAL CITY BOLT COMPANY.

Syracuse.

In 1863 Messrs. Bell & Marcellus, bolt makers of Amsterdam, N. Y., removed their works to Buffalo, N. Y., where, after a number of changes, it was translated into what is now known as the Buffalo Bolt Company, whose works are located at North Tonawanda, N. Y. When Mr. James P. Marcellus severed his connection with this company in 1865, he purchased a bolt header and hot press nut machine of Orrin C. Burdick, which he ordered shipped to Syracuse, N. Y., where he tried the unsuccessful experiment of employing convict labor in the penitentiary. Afterwards he became associated with Pope & Alexander, later known as the Syracuse Bolt Co., the name of which, under the present management, was changed to the Central City Bolt Co. in 1889, the officers being E. B. Judson, Jr., president; W. S. Purington, vice-president, and J. Walter, secretary and treasurer.

In the year 1900 Mr. Purington purchased the interests of Messrs. Judson and Walter and reorganized the company with the present officers: W. S. Purington, president and treasurer, and Levi S. Chapman, secretary. The company manufactures common carriage bolts, chiefly using the Chapin header. They also make Philadelphia Eagle Carriage Bolts and machine bolts, and a specialty known as "The Barry Parlor Door Hanger," which commands an extensive sale.

Mr. Peter Featherstone, present foreman of the heading room of The Central Bolt Co., and who has worked at the business from boyhood, claims to have made the first common carriage bolts manufactured in that city in 1865, although Messrs. Pope & Alexander had been running a few bolt machines two years previous to that date, and also prior to the arrival of Mr. Marcellus in Syracuse. After undergoing several changes their establishment became known as The Syracuse Bolt Co.

In 1901 The Central City Bolt Co. purchased and are now occupying spacious new buildings on Salina and Park Streets, which are equipped with the finest modern machinery, where they are doing a highly prosperous and increasing business.

SKANEATELES BOLT COMPANY.

Skaneateles.

The Skaneateles Bolt Co. of Skaneateles, N. Y., was founded in 1866. Spacious and well appointed buildings were erected and bountifully provided with the most approved machinery that the market afforded at the time, including Olivers and other forgers, also heading and nut machines. A rolling mill was also connected with the works and to all external appearances the plant gave promise of a prosperous future. Mr. A. Bean, a hardware merchant, was appointed secretary, treasurer and general manager, and Mr. Northrup, an experienced bolt and nut maker of New Haven, Conn., was made superintendent.

With all of its apparent advantages, the venture proved unprofitable. It continued in business, however, until 1870, when the enterprise seemed, like "The Deacon's One Horse Shay," to fall into dissolution by its own weight and friction. The facts leading to the disaster we are unable to ascertain.

SECTION V.

RHODE ISLAND.

WILLIAM H. HASKELL MANUFACTURING COMPANY.

Pawtucket.

The important and prosperous manufacturing center of Pawtucket, R. I., has undisputed claims to having been one of the nuclei of the bolt and nut industry of America, as the history of Rhode Island and Providence Plantations and the records of Pawtucket show conclusively that the birthplace of the nut industry in America was Pawtucket, with the bolt business a close second.

In 1820 Col. Stephen Jenks, a skilful mechanic and general blacksmith, commenced to make bolts in the usual manner of the period, supplying his immediate patrons, on orders at his blacksmith shop, known as the "Old Forge Shop," whose site is now occupied by the immense works of the Pawtucket Manufacturing Company.

Colonel Jenks' business gradually drifted into the bolt and nut industry, which he conducted until his death, Nov. 23, 1837, when the business was continued by his son, Joseph, and Joseph T. Sisson.

About the year 1855, a firm known as Pinkham, Haskell & Co., succeeded to the business, and sold out to W. H. Haskell in 1857. Mr. Haskell added new machinery and new lines of manufacture. In 1860 Haskell vacated the old



George H. Kell

edifice and reared the new and commodious buildings now occupied on Main Street. These buildings were finished in 1861, and the firm of William H. Haskell & Co. was established, the junior partner being Robert Sherman.

In 1881 Daniel A. Hunt was admitted as a partner, and the company was incorporated.

In 1898 a new charter was obtained under the title of The William H. Haskell Manufacturing Company. At this time The Pawtucket Nut Co., owned by Jacob Stephens, was absorbed by the Haskell Company, Mr. Stephens becoming general manager through the deal. The William H. Haskell Manufacturing Co. still carry on a highly successful business. They are up to date and their goods rank among the best the market affords. Their business is ably conducted by the following officers: Alfred M. Coats, president; E. Shirley Greene, secretary; J. Milton Payne, treasurer; Jacob Stephens, general manager.

GEORGE H. WEBB.

George H. Webb was born in Simmonsville, R. I., Nov. 17, 1845. His parents died when he was a small boy and he was left with no resources, except a robust little body, a cheerful and buoyant mind and a determination to succeed in life by the force of industry and perseverance. Obtaining employment at light work in a mill, he earned his livelihood and by earnestly devoting his leisure hours to study, he obtained a fair education. Young Webb had a natural taste for machinery, and during his service in the mill he acquired knowledge and experience that proved of great value when he entered a broader field of industry.

Young Webb left his native village in March, 1866, and secured employment with William H. Haskell & Co., Pawtucket, R. I., where his knowledge of machinery increased and expanded so rapidly that he soon became recognized as an ex-

pert. He spent sixteen years with Haskell & Co., during the last ten of which he was regularly employed in designing and constructing machinery.

The Pawtucket Manufacturing Company was organized in 1881, and a charter was obtained in May, 1882, with George Henry Webb as general manager, a position that he has held with the utmost ability and success, and the duties of which he is still fulfilling. From a small beginning this successful company has steadily grown and advanced until it occupies an honorable place among the largest and most prosperous and reputable establishments of the kind in the country and it may be said without flattery that its splendid success has been measurably due to the business ability, perseverance and stern integrity of its general manager. Since 1895 Mr. Webb has served the company in the double capacity of general manager and treasurer. It has always been the aim of Manager Webb to make the product of his factory conspicuously notable for its superior quality and no pains have been spared to attain this end. As a consequence the product of the factory stands among the highest in all markets.

Mr. Webb's business career exemplifies what can be accomplished by industry, perseverance and intelligence judiciously employed. Virtually self-taught, he has become one of the most ingenious and useful inventors in the country. He is the author of sixteen valuable patents for improvements in the construction of bolt and cold pressed nut machinery and he has done much toward improving and perfecting this class of machinery and its product. On account of his superior knowledge, judgment and experience, Mr. Webb is frequently consulted by others engaged in his line of business.

It seems appropriate to say a few words here, of the venerable Stephen A. Jenks, president of the Pawtucket Manufacturing Company, an earnest co-worker with Mr. Webb. Mr. Jenks is the only living direct descendant, now actively engaged in the bolt and nut business, of Col. Stephen Jinks,

one of the earliest pioneers in this line of industry. Col. Jinks was born March 31, 1756, and died Nov. 21, 1837. His business dates back to 1820, since which members of the Jinks family have been actively connected with various departments of the bolt and nut business in Pawtucket. At the age of 72, President Jinks actively participates in the business affairs of the company, and is gracefully rounding out the long and honorable connection of his family with the bolt and nut industry.

RHODE ISLAND TOOL COMPANY.

Providence.

In tracing out the nut industry of Rhode Island the writer is largely indebted to Mr. George H. Webb, treasurer and general manager of the well-known Pawtucket Manufacturing Company. Mr. Webb writes under date of November 24, 1903: "The Historical Sketches of Pawtucket prepared by the Rev. Massena Goodrich, under the authority of the Town Council, in 1876, are as near correct as anything I can discover. All of the old timers with whom I consulted, after carefully reading the work, came to this conclusion. Mr. Goodrich, by request of the city officials, prepared the book and it was published by their order.

It commences: "Messrs. Jeremiah O. and Joseph Arnold in 1834 or 1835 started the first press for making iron nuts. It was set up on the Moshassuck River, near and where now stands the extensive bleachery of Messrs. Sayles. After a little while the firm was dissolved and a new firm formed, consisting of Jeremiah O. Arnold and a Mr. Field, who transferred their business to Pawtucket."

From this it would appear that Moshassuck River and the Sayles Bleacheries were quite a distance from Pawtucket.

They were so considered at that time, but are now in the city. It was about a mile from the center of the Main Street bridge, which we now term the center of town. As this distance was through a forest, it at that time seemed a long distance. Where our own works stand now, only a quarter of a mile from the bridge, stood a pine forest, which was not cut down until about twenty-three years ago.

“These gentlemen added to their business the making of bolts. This proves conclusively that they started the nut business first. You will notice in the second paragraph ‘that Mr. Franklin Rand entered the field. He first occupied the old grist mill house which, perched on the rocks, outrode the freshet of 1807. He set up a press there for punching iron in 1843. The next year he took as a partner Mr. Joseph Arnold and they remained together until 1847.’ At the beginning you will notice that Jeremiah O. and Joseph Arnold, in 1834 or 1835, started the first press for making nuts. These are the same presses that Franklin Rand says he set up in the same building in 1843, and without doubt the presses were run in '44 and '45 by the two Arnolds.

“And here, perhaps, may fitly come in the reminiscences of an aged man, who was born in Smithfield four score years ago:

“I was acquainted with some of the older inhabitants of Pawtucket seventy years ago. I saw the great freshet which carried off the bridge and Pardon Jenks’ old buildings. Mr. Jenks said: ‘I have lost all my property; I am a poor man.’ He was asked how much he would take for his rocks, where the building stood. ‘I will take forty thousand dollars,’ was the answer. I came to Pawtucket when I was twenty years old, and worked for David Wilkinson. In 1817 I helped erect a machine for making Scotch plaid. In 1818 I helped build a steam engine for Dr. Wadsworth to run a steamboat in Providence. In 1819 I built the first bed-tick loom. I saw the first loom run by water power. It was made to stand

upright. (This was probably Thorp's loom.) In 1824 I helped build a hydraulic press. In 1845 I made the first dies for twisting augers under trip-hammers. In 1846 I took charge of the shop called the Providence Tool Company. They ran seven presses for making nuts and washers. (The first press I built for this kind of work was in 1833.) I started ten presses for the Providence Forge & Nut Company — one a very large press. I punched nuts four inches in diameter, two inches thick, from cold iron."

JERE O. ARNOLD.

"This account has value, not merely as containing a record of the personal experience of an octogenarian, but as showing the variety of work performed in the machine shops of Pawtucket half a century ago." The foregoing was written in 1876.

In 1833, shortly after Mr. Arnold completed his first cold nut press, he formed a partnership with his brother Joseph and continued the manufacture of cold punched nuts. They occupied a small shop on the Moshassuck River. In later years they dissolved partnership and it appears Jeremiah O. Arnold and William Field jointly carried on the business for a short time, when Mr. Field withdrew and commenced the manufacture of augers and kindred tools. He removed to Providence in 1840 and founded the afterwards well known Providence Tool Company, whose principal business was manufacturing cold punched nuts and washers. This was their first works, styled "the lower works," located near "Fox Point." During the early forties, a firm bearing the name of The Providence Forge & Nut Company, came into existence, which soon after consolidated with or was absorbed by The Providence Tool Company, and was known as their upper or North End Works. It was at this time The Providence Tool Company acquired a very large interest in the nut and washer business. In 1882 or thereabouts The Providence Tool Company became embarrassed, and the works were

divided, the lower works taking the name of The Household Sewing Machine Company, as the manufacturer of sewing machines. At this time it was their principal business, although they were also engaged in the manufacture of guns for the Turkish Government at the time of their embarrassment. The Upper or North End Works, adjoining the famous William Harris, Corliss steam engine factories, adopted the style of The Rhode Island Tool Company, under which title it has done a highly successful business since. In the manufacture of bolts, nuts and washers of the various varieties at this factory, the large press Mr. Arnold referred to is still doing excellent work, practically six days a week, a remarkable record for a machine built nearly fifty years ago. It was not until after the organization of The Rhode Island Tool Company that the manufacture of bolts became a part of the business.

In 1843 Franklin Rand entered the field. He commenced business in an old grist mill erected in the 18th century. Quoting from Rev. Goodrich, "He set up a press there for punching cold iron." On the next year he took as a partner Mr. Joseph Arnold, and they remained together until 1847. From that time Mr. Rand was alone till 1863. He introduced an innovation in his business. Before his experiments it was thought that the maximum was reached, when nuts were punched from cold iron one and one-half inches broad by three-fourths of an inch thick. He soon punched nuts two and one-half inches broad by one inch thick. Mr. Rand built the largest press for this purpose that then existed in the country. He was ridiculed in advance for his undertaking; for his wheel was deemed too small for the object. But he taxed its full power, and showed that, as the business originated in this neighborhood it was capable of great perfection here. "Further, the deponent sayeth not."

PAWTUCKET MANUFACTURING COMPANY.**Pawtucket.**

The Pawtucket Manufacturing Company, Pawtucket, one of Rhode Island's best equipped and largest bolt and nut establishments, was organized in the fall of 1881, and received its charter of corporation in May of the following year. They manufacture a full line of bolts and nuts, and bolt and nut machinery. This company has built up a trade and reputation, of which the City of Pawtucket may well be proud. The present officers are: Stephen Jenks, president; Alfred J. Webb, superintendent; George H. Webb, treasurer and general manager.

THE EASTERN BOLT & NUT COMPANY.**East Providence.**

In 1901 The Eastern Bolt & Nut Company was organized and commenced shipments in 1902. This company located their works in East Providence on the opposite side of the Seakonk River. Their machinery was installed very largely by The Pawtucket Manufacturing Company.

A SUMMARY.

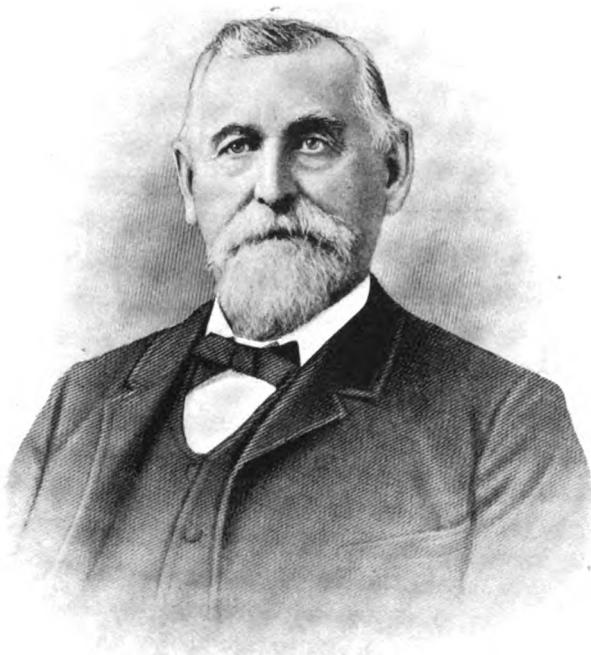
Summarizing the foregoing as to priority in the business, The William H. Haskell Manufacturing Company are the legitimate successors in a direct line of successions from the Elder Colonel Stephen Jenks, whose business dates back to 1820, in the making of nuts and bolts. The cold nut business of The Rhode Island Tool Company had its origin with the Messrs. Arnold in 1833, and came to them in the following order: Providence Tool Company, 1840; Providence Forge & Nut Company, 1846; Rhode Island Tool Company, 1882, at which time the latter company installed bolt making ma-

chinery, which was the third plant for that purpose in the State. The Pawtucket Manufacturing Company organized in 1881, being the second parties to make bolts for the trade, followed by The Eastern Bolt & Nut Company in 1901.

Pawtucket was among the very first New England towns to engage in the iron industries, and as a natural consequence bolts and nuts were made and used in the construction of machinery during the 18th century. But it did not develop into a merchantable business until during the forties of 1800, when the business spread to Providence, and soon after the kindred business of making stove and tire bolts and wood screws was taken up by The Bay State Screw Company of Taunton, Mass., and various other wood screw companies in Providence, R. I., all of which have since merged into The American Screw Company of Providence. To these screw factories much of the automatic machinery used in bolt and nut works to-day is directly traceable, and the success of the bolt and nut business is largely due, which is more fully explained in another part of this work.

WILLIAM H. HASSELL.

William Henry Haskell, one of the leading manufacturers of Pawtucket, was born in Cumberland, R. I., September 1, 1821. He was educated in the district schools of his native town, and worked on his father's farm until he was 18 years of age, when he began to learn the machinist trade with Ebenezer and Joseph Metcalf in Cumberland. He worked with them until 1840, when he went to Woonsocket, and the following year to Fall River, working at his trade in both places. With the experience thus acquired he concluded to establish himself in business. In 1845, in connection with Nathaniel S. Collyer, he opened a shop on Mill Street, Pawtucket, which he and his partner carried on for four years, meanwhile developing the business to such an extent that from twenty to thirty men were constantly employed.



Wm. H. Haskell

In 1850, in company with Curtis Collyer and Lewis T. Haskell, his younger brother, he bought an interest in the bolt and screw manufacturing plant of Pinkham & Jenks, and the new firm was organized as Pinkham, Haskell & Co. In 1857 he purchased his brother's, Mr. Collyer's and Stephen A. Jenks' interests in the firm and became sole owner. In 1861 Robert Sherman entered the firm as a special partner and continued as such until 1868, when Mr. Haskell bought him out. This industry was the successor of an old machine shop established in the first years of the century by Col. Stephen Jenks. Under Mr. Haskell's management the production of the bolt and nut shop was rapidly increased, so that the necessity soon arose for the enlargement of the works. This undertaking was begun in 1860 and completed in 1861, when the large shops on Main Street were put in operation. The first building erected was considered mammoth in its proportions, being 100 feet long by 40 feet wide, and two stories high. But in a few years the increase of business demanded its enlargement to 350 feet long by 50 wide, and about 150 employees were required to operate it. The specialties manufactured are bolts, nuts, washers and coach screws. The industry has been uniformly successful and has furnished continuous employment to a large number of skilled mechanics. The present annual production is now valued at about \$200,000. The concern was incorporated as The William H. Haskell & Co. in 1881.

While giving his best energies to the development of this great business, Mr. Haskell did not neglect his duties as a citizen. He has represented the people in many positions of trust and honor, and has served as town councilman, water commissioner, State senator, and on many boards and commissions. Politically he was originally a Whig, but previous to the war he joined the Republican party. He has always had the respect and confidence of his fellow citizens in a

marked degree, and his character and conduct has justified his record. He is a director in the Pacific National Bank.

Mr. Haskell was twice married, by which unions there were three children, of whom two daughters are living. He is descended from a family whose longevity is remarkable. His grandfather, Samuel Haskell, was 95, and his grandmother, Mary Haskell, 91 years of age, and both died in the same year, 1849. They were among the first settlers of Cumberland. His father, Turner Haskell, was active in public life and served both in the town council of Cumberland and the general assembly of Rhode Island for many years. He lived and died in the town of Cumberland and was 73 years old when he passed away in 1863. His mother, Patience (Smith) Haskell, died in 1883 at the ripe age of 89. His parents had nine children, of whom William H. was the second son.

NEW JERSEY.

WILLIAM HAMPTON & COMPANY.

Gloucester.

In 1843 William Hampton & Co. established a small plant at Gloucester, N. J. They used a homemade swinging hammer for forging, which was patterned after the Golcher English Oliver. Beside bolts and nuts the company manufactured gun locks and a few other specialties. A few months after launching the enterprise, Mr. Hampton purchased the interest of his partner, paying for it with potatoes, onions and other garden truck. The business continued under Mr. Hampton's management until 1847, when it was sold to Mr. Golcher of Philadelphia.

WILLIAM GETCHELL.
Rahway.

In 1854 Mr. William Getchell established a bolt and nut factory in Rahway, N. J., which he supplied with steam power and six Olivers. He also employed one of the first Pittsburgh or Lewis heading machines placed on the market, after which his principal product was pinched-neck carriage bolts. He did a fairly successful business until 1868, when he experienced a change of heart and sold out his works for the purpose of becoming a member of the clergy. To most people who are familiar with the bolt and nut making trade, the analogy between forging nuts and forging sermons may appear somewhat remote; but, nevertheless, the sturdy Mr. Getchell abandoned the forge for the pulpit and became a Methodist minister, an example that has not been very generally emulated among the makers of bolts and nuts.

FULLER, LORD & CO.
Boonton.

Messrs. Fuller, Lord & Co., proprietors of extensive iron works in Boonton, N. J., began making hot pressed nuts in connection with their other business, in 1864. After continuing the business for a few years, they abandoned this branch of their trade and disposed of their machinery. The company is still engaged in the manufacture of iron of various kinds, under the management of Mr. Lord, who has a business office at No. 59 Wall Street, New York City.

CRANE BROTHERS.**Newark.**

In 1865 Crane Brothers equipped a factory with six Olivers and other necessary appliances, and began manufacturing a variety of bolts and nuts. Like that of many others who were wedded to the Philadelphia Oliver method of bolt making and therefore unable to wake up to the adoption of the more modern machines, the history of this company is chiefly noted for its brevity.

CUNNINGHAM & McFALL.**Newark.**

In 1869 Patrick Cunningham and Hugh McFall began making fancy step, shaft and seat bolts in a small shop on Mechanic Street, Newark, N. J. They employed three Olivers. After two years of unsuccessful business they removed to Birmingham, Conn., where they soon after sold their Olivers to D. N. Bassett and stored the remainder of their effects until corroding time rendered them worthless and added one more record of blasted hopes to the formidable list of failures in the bolt and nut business.

MASSACHUSETTS.**AMERICAN BOLT COMPANY.****Lowell.**

The American Bolt Company of Lowell, Mass., was established in 1847 by two workingmen, under the title of Smith &

Meadowcraft. Mr. Meadowcraft was an Englishman, a blacksmith by trade and a very clever mechanic.

In 1855 the style became Smith, Meadowcraft & Sherman. Mr. Sherman took charge of the books.

In July, 1857, the style was changed to The American Bolt Company. They gradually drifted into the cold punched and washer business, using the old "Grasshopper" presses, and making nuts up to $3 \times 3 \times 1\frac{1}{2}$ inches, with machine bolts, etc., to correspond.

Their bolt product was made by hand until 1864, when Mr. James Minter of Worcester, Mass., secured a patent on a heading machine, known as the American bolt heading machine, which became the property of the company. It is an upright hammer machine, designed for making square and special heads. It has been chiefly used by this company. It does excellent work, but it found but a moderate sale on the general market, as it is not sufficiently speedy to satisfy the demands of the trade. In 1881 the company was incorporated with a capital stock of \$100,000. Arrangements were recently completed to consolidate this company with The Southern Bolt & Nut Company of Birmingham, Ala., whence the works have been removed. The managing officers of this company were: Paul Butler, president; Percy Parker, treasurer.

JOSEPH ROBINSON & SON.
Cambridge.

In 1868 Joseph Robinson & Son of Birmingham, Conn., began manufacturing Philadelphia carriage bolts on a small scale at Cambridge, Mass., using Olivers for forging. During the following year, what proved an unprofitable business was closed and the tools and machinery were sold at auction.

W. H. TILDEN.

Walpole.

In 1868 a hardware merchant of Boston, who supported the military title of Gen. W. H. Tilden, began manufacturing wagon springs and carriage bolts at the little suburb of Walpole, about eighteen miles from "The Hub." He operated ten Olivers, with the other necessary machinery for making Philadelphia carriage bolts, using water power to run his works. Although Mr. Tilden started his business with a good line of credit, a well equipped factory and apparently brilliant prospects, it proved a complete failure and was closed out in a few years.

What became known as "Pat, the wonderer's coup d'etat," connected with this failure, caused considerable merriment among the villagers when the facts became known. Pat was a shrewd, expert bolt maker, to whom Mr. Tilden was indebted something over \$200 for arrearage in wages. On the day previous to the failure Pat's suspicions were aroused and he determined to make strenuous efforts to collect what was due him. At the telegraph office he secured a message blank, which he addressed to himself and filled out with the message: "Your mother-in-law is dead; come home at once." This he presented to Mr. Tilden, pleading the emergency of the case and demanding the balance due him, so that he could take the evening train for home. Mr. Tilden was exceedingly sorry that he could not give him the money that day, but finally offered him a due bill for \$200, which, he suggested, Pat could get cashed in the village. Pat thought so, too, and accepting the due bill, he waited till late in the night, and then, pleading the emergency of his case, he routed out of bed a prominent Jew clothing dealer, to whom he showed his telegram, and negotiated for a suit of clothes and other articles, offering the \$200 due bill in payment. The clothier regarded the due bill as perfectly good, but had not enough money to pay the balance over the purchase.

"Well," said Pat, "that's all I have. I'd had it cashed at the bank in a minute but the bank was closed, and I wanted some clothing for the funeral, so I thought I'd kill two birds wid one stone by comin' to you. You must be quick about it, or I'll have to go on wid out the clothes."

Rather than lose the sale the clothier aroused a neighboring Israelite, who loaned him a sum sufficient to close the transaction and Pat went on his way rejoicing and reached the depot just in time to take the midnight train for his home at Philadelphia.

Perhaps the unfortunate clothier's feelings can be imagined better than described when the failure of Tilden's establishment was announced on the following day. But, so far as Pat was concerned, he always maintained that his share of the transaction was perfectly legitimate, and that he was in no way to blame for Tilden's failure.

THE BOSTON BOLT COMPANY.

Boston.

The Boston Bolt Company absorbed and succeeded The Boston Nut Company in 1875, establishing their works at South Boston and their offices and sales department on Purchase Street, Boston, Mass. They manufacture an extensive line of articles, including bolts and nuts, lag screws, washers and a variety of forgings for bridge and car building. The company also conducts a large jobbing trade in heavy hardware and supplies. Their present offices, in charge of W. H. Swift, manager, are located on Franklin Street, Boston.

NEW ENGLAND BOLT & NUT COMPANY.**Boston.**

Howard S. Hill and Everett W. Farmer, practical bolt and nut makers, both of Boston, Mass., formed a partnership in February, 1897, capital being furnished by Walter B. Farmer, also of Boston. They leased the basement at No. 307 Atlantic Avenue, and installed two bolt headers, three threading machines, one tapping machine, two forges and one trip hammer. The business grew so rapidly that a company was incorporated in December, 1897, and capitalized at \$30,000. The officers were Walter B. Farmer, president; Everett W. Farmer, treasurer, and Howard S. Hill, Walter B. Farmer and Everett W. Farmer, directors. To meet a demand for increased facilities, on January 15, 1898, the company leased land for a term of years on Atlantic Avenue, on which a five-story brick building was erected, and the premises were occupied August, 1898, and fitted with the most improved machinery. A short time later a galvanizing plant was added. The business continued to be successful and grew rapidly. On October 9, 1900, Treasurer Everett W. Farmer resigned and Howard S. Hill was elected president; Walter B. Farmer, treasurer, and Edgar Speare was added to the board of directors. Another enlargement occurred in July, 1901, when the company purchased three acres of land at Everett, four miles from Boston, on the Boston & Albany and Boston & Maine Railroads, on which was erected a commodious main building and also a large galvanizing building, which were built in the latest improved manner, glass being used extensively in order to secure abundant light and air.

On July 29, 1901, the capital was increased from \$30,000 to \$75,000, using the proceeds to purchase additional machinery. October 8, 1902, William H. Allen, Jr., of Boston, was elected a director in place of Edgar Speare, resigned. The office, drafting rooms, store and stock room of the company

are at 263 Atlantic Avenue, and all manufacturing is done at Everett, except castings, which are principally made by a foundry controlled by the company.

The officers elected at the annual meeting in 1903 are: Howard S. Hill, president and general manager; William H. Allen, Jr., vice-president and manager of the structural department, and Walter B. Farmer, treasurer.

ILLINOIS.

ROCKFORD BOLT WORKS. *Rockford.*

The Rockford Bolt Works is one of the prominent manufacturing institutions of the thriving city of Rockford, Ill., sometimes called "The Lowell of the West." It was established in 1862 by John H. Manny, of reaper and mowing machine fame. At that time Mr. Manny was obliged to procure his supply of bolts for building machines at Portchester, N. Y., and on account of the long delay in transit and the high price of the product at the time, he introduced bolt making machines to supply his needs. He manufactured for his own use, until 1865, when Gilbert Gunsaul of Freeport, Ill., and George Chapman of Rockford, Ill., formerly of Amsterdam, N. Y., concluded that bolts could be profitably manufactured to sell to the trade. They formed a co-partnership under the name of Gunsaul & Chapman, and purchased the machinery of Mr. Manny, also adding other machines. This co-partnership was carried on until 1869, when Mr. Chapman sold his interest to Mr. Wilkins of Milton, Pa., who moved to Rockford, and the firm name was changed to Gunsaul & Co. The

product of the company is sold directly to consumers, especially to the agricultural implement trade, and this has been the policy of the company up to the present time.

Mr. Gunsaul died in 1871 and his interest was purchased by Aaron Marcellus of Amsterdam, N. Y., who had been connected with the bolt making works of George C. Bell. The firm was then changed to Wilkins & Marcellus and continued under this name until 1877, when Mr. Marcellus died, and his interest was purchased by S. B. Wilkins, the surviving partner, and the business was continued as The Rockford Bolt Works, S. B. Wilkins, proprietor.

In July, 1877, a company was incorporated under the laws of the State of Illinois, as The Rockford Bolt Works, and the following officers were elected: S. B. Wilkins, president and manager; R. H. Tinker, vice-president; C. R. Wise, secretary and treasurer.

Mr. Wilkins remained with the company as president and manager until 1885, when he disposed of his interest and the following were then made officers of the company: R. H. Tinker, president; H. N. Starr, vice-president; C. R. Wise, secretary and manager. Since then the business has been in charge of C. R. Wise.

The machinery used in 1862 was the Chapin headers and open die, two-jaw threading machines. These machines were followed with Lewis headers for machine bolts and later on with new types and improvements of their own inventions and experience. Their product is carriage, machine, plow bolts, coach screws, rods and odd bolt work to order.

The buildings are one three-story stone building, 50 x 80, with forge shop in the rear 60 x 80. Also one stone building three stories, 40 x 80; one blacksmith shop, 16 x 20, and one new building in process of construction, 75 x 100, for additional forging room and iron and fuel warehouses. The motive power is by water wheels and electricity.

The company has been fortunate in not having any fires

except in March, 1871, when their buildings were burned to the ground, occasioned by the burning of adjacent buildings and causes beyond their control. They were fully insured and new buildings were erected quickly, with very little inconvenience to the business.

According to the census of 1900, Rockford had a population of 31,054. The city is beautifully located on both sides of Rock River, 92 miles west of Chicago, and has an extensive supply of water power. It is profusely adorned with stately shade trees, to which it is indebted for the nom de plume of "The Forest City" of Illinois.

CHICAGO.

While Chicago has long been pre-eminent as a market and distributing point for bolts and nuts of every description, few of the repeated attempts to establish the bolt and nut industry in the great western metropolis have proved permanently successful. This is undoubtedly accounted for by the fact that nearly every one of the large eastern bolt and nut factories established extensive distributing depots and agencies in Chicago and supplied them with such ample facilities to compete for the local and western trade that local manufacturers were placed at a disadvantage and found it so difficult to cope with the enormous volume of eastern competition that they in turn abandoned the field.

During the eighties Chicago had a number of reasonably well equipped bolt and nut factories, all of which have passed out of existence. Among these were The Standard Bolt Company, The American Bolt Company, The Eclipse Bolt Company, The Chicago Forge & Bolt Company and The Shurway & Burgess Company. Since these companies discontinued business but two exclusive bolt and nut factories have been established in the city of Chicago — The Continental Bolt & Iron Works, Union and Twenty-second Streets, which

appears to be doing a satisfactory business, chiefly in the manufacture of large bolts, nuts, washers and turnbuckles, and The Union Bolt Company, chiefly controlled and supplied by eastern manufacturers. Aside from these this branch of industry has been virtually abandoned, except by a few heavy home concerns that manufacture bolts and nuts for their own consumption. Among the larger manufacturing establishments that are provided with special bolt and nut departments are The Pullman Palace Car Works, The McCormick Mower & Reaper Works, which has a large bolt and nut department, employing fifty-two heading machines, with modern equipment to correspond, and a few others. As their product is not marketed, however, and are only manufactured for home use, they are not classed as bolt and nut factories.

In the way of inventions of bolt and nut machinery, however, Chicago stands credited with a number of machines which have gained considerable prominence in the manufacturing world. Among these, the Cook automatic nut tapper, manufactured by The Capital Manufacturing Company; the James H. Haskins automatic tapper; screw-thread cutting and pointing machinery by Orlando P. Briggs, George W. Parker, George Weiss, Oscar Johnson, James A. Plopper and Olof Hoyer.

THE FOREST CITY BOLT COMPANY. Rockford.

In 1884 The Forest City Bolt Company of Rockford, Ill., was incorporated by W. W. Bennett, Peter Sames and J. D. Waterman. The officers elected were Peter Sames, president; W. W. Bennett, vice-president; Frank Lane, secretary, and J. D. Waterman, treasurer.

The company occupied a fine building, which was fairly equipped with modern machinery, and so located as to be supplied with admirable shipping facilities. To all appear-

ances the company entered the field under the most favorable auspices; but, from causes never fully explained to the inquisitive public, its lease of life was limited to but two brief years, when a suspension occurred and the stockholders found themselves heavily in debt.

Soon after the failure occurred, the bolt and nut machinery was sold at a sacrifice to The Rockford Bolt Works of the same city, and the building, main shafting, boiler and engine, heating apparatus and the other effects were held by Mr. Peter Sames, who still holds them as a sad memento of a wrecked enterprise, and is now using same as a wagon factory.

COBB & DREW.

Rock Falls and Plymouth.

The firm of Cobb & Drew of Rock Falls, Ill., make a specialty of rivets of every description. Their principal factory is in Plymouth, Mass., where it was established in 1848. The Rock Falls branch was started in 1896. In 1902 machinery was introduced for making stove and tire bolts, and at the present time they are installing machinery for making their own cold pressed nuts.

INDIANA.

BOLT & NUT WORKS OF THE REPUBLIC IRON AND STEEL COMPANY.

Muncie.

During the earlier history of this now large and prosperous company, it seems to have yielded to a propensity for wandering zigzag about the country until it finally secured a permanent anchorage in its present location.

The parent company was organized in Mansfield, Ohio, in 1884, and was known as The Mansfield Bolt & Nut Company. The officers were: L. A. Cobb, president; Jake Cottner, Jr., vice-president; H. Johnson, treasurer; Edward Marshall, secretary; G. O. Cromwell, manager, and H. E. Coy, superintendent.

The principal incentive in the formation of the company was to put in operation and develop an ingeniously constructed machine for gimlet pointing coach screws, which had been invented and patented by Mr. H. E. Coy of Cleveland, who was one of the promoters and subsequently superintendent of the company. The patent was awarded the same year that the company was organized, and it was believed that it would prove an exceedingly valuable invention.

Its modus operandi was to receive the coach screw, after it had been threaded by a screw cutting lathe, in a split nut that closed on the thread and acted as a lead screw to propel the carriage along to the point former which shaped the gimlet point. The tool was carried towards the center of the screw as it traveled along its axis, and was forced downward with a hand lever to perform the work, thus completing the screw in two operations. The capacity of the plant was about 50,000 bolts and screws per day.

The business in Mansfield proved so unsatisfactory that the company was reconstructed at the expiration of one year, when its effects were removed to Toledo, Ohio, where it became known as The Toledo Bolt & Nut Company, and the following officers were elected: L. A. Cobb, president; W. A. Gosline, vice-president; F. B. Dodge, treasurer; G. O. Cromwell, secretary and manager, and H. E. Coy, superintendent.

The capital stock of the company was \$100,000 and the capacity of the plant was increased to a total of 150,000 bolts per day.

In 1886 Mr. H. E. Coy constructed his improved gimlet pointing machine, which employed a rotary cutter that pro-

duced the gimlet point and the thread on the body of the coach screw by a single operation. The main feature was a rotary cutter driven horizontally and carried in such a position that its relation to the central axis of the screw was changed as it traveled from its extreme point (or dead center) to the position necessary to cut the complete thread. The blank was confined in a slotted sleeve and revolved towards the upper edge of the cutter, while forming the thread and gimlet point. This machine did unsurpassed but not rapid work, and is still being used by the present company.

The business was continued in Toledo until 1892, when a combination was formed with a rolling mill company in Lancaster, Ohio, and both concerns were removed to Muncie, Ind., and consolidated under the title of The Indiana Iron Company, with a capital stock of \$250,000, and the following were elected officers: L. A. Cobb, president; F. Pratt, vice-president; G. O. Cromwell, treasurer and general manager, and G. M. Bard, secretary.

At an election of officers in 1895 the following were chosen: F. Pratt, president; G. M. Bard, vice-president and general manager, and William Myers, secretary and treasurer.

The product of the establishment consisted of bar iron of every kind, bolts, nuts, bridge rods, gimlet pointed coach screws, etc., with a daily capacity of 250,000 bolts, 15 tons hot pressed nuts and 130 tons of bar iron.

In 1897 the company was absorbed by The Republic Iron & Steel Company, under whose management the business has been largely increased and is still conducted. The present superintendent of the bolt department is Mr. John M. Stetter.

THE ANDERSON BOLT & NUT COMPANY.

Anderson.

What was known as The Anderson Bolt & Nut Company of Anderson, Ind., was originally organized at Fowlerville,

N. Y., in 1885, by Fowler & Sons, extensive heavy hardware dealers of Buffalo, N. Y. The officers were: E. H. Fowler, president, and J. S. Fowler, secretary and treasurer. After being in operation about two years the works were so seriously damaged by fire that the machinery and effects preserved were removed to Anderson, Ind., in 1887, where a plant with a capacity of 50,000 bolts per day was established and operated until 1895, when the entire business was sold to The Lake Erie Iron Company of Cleveland, O. This company dismantled the plant and removed the machinery to their Cleveland works, a year later.

MICHIGAN.

MICHIGAN BOLT COMPANY.

Detroit.

In the summer of 1863, the first action was taken that resulted in the establishment of a bolt and nut manufactory in Detroit.

Joseph Briscoe had built in the shops of the Grand Trunk Railway a machine for making cold pressed nuts, with a capacity for $\frac{5}{8}$ inch and smaller, nuts and washers. This machine was set up in February, 1864, in a shingle factory owned by Augustus Day, on Atwater Street, near Rivard, and was operated in the same shop for two years, at which time it was moved to the shops of The Detroit Locomotive Works on Third Street, between Congress and Larned. A larger machine, with a capacity for $1\frac{1}{8}$ inch nuts, and two smaller machines, were added to the equipment.

About this time George B. Hill, who had been running a shingle factory and found it unsatisfactory, built a cold pressed nut machine, medium size, and set it up in his shingle

mill on Riopelle Street. Shortly thereafter, a third manufacturer appeared upon the field in the person of Louis Thiery, a mechanic from the Grand Trunk Railway shops, who built two machines, setting them up directly across the street from Mr. Hill's. These two latter concerns, shortly afterward, consolidated.

About this time Mr. Briscoe interested other capital and additional executive ability in the person of Louis Sevigne, and they bought the right for Indiana and Michigan to manufacture the machine-forged nuts, under the Koch patent, and were known as the Michigan & Indiana Bolt & Nut Co.

In 1868 a new deal was made by which both concerns were merged into one, with a capital stock of \$20,000, in which Messrs. Hill, Briscoe, Thiery, Sevigne and Smith were equal partners, and the name was changed to the Michigan Bolt & Nut Co., and a factory was built on Wight St., at the foot of Iron St., in 1868-9.

The business, under the active management of Geo. B. Hill as general manager, and Louis Sevigne as superintendent, was gradually enlarged, and additional buildings added as the old quarters became too straitened. A forge department was added to the nut and bolt shop. Following the panic of 1873, the company failed, and was operated about half a year by Dr. Cobb as assignee, and was then sold in the fall of 1875, being bought in by Geo. B. Hill, for himself and his sister, Miss Sarah B. Hill. With the returning good times came another season of rapid development under the able management of Mr. Hill. In 1880 the business was incorporated under the name of the Michigan Bolt & Nut Works, with Geo. B. Hill, Sarah B. Hill and Louis Sevigne as the original and only stockholders. Capital stock, \$100,000.00.

In 1882 it was found necessary to enlarge their quarters again, and, being unable to purchase ground on either side of their plant on the south side of Wight St., it was determined

to buy on the north side of Wight St., almost directly across the street. Upon this a brick building 50 feet by 240 feet was erected and occupied in 1883, as a nut shop and office building, and a season of substantial growth followed.

In the summer of 1890 Mr. Hill's health began to fail, and he was obliged to give up active management of the business, which he had carried almost alone for twenty-two years. The decline in his health was rapid at first, and then more gradual, until May 17th, 1894, when he passed away, after having put in the best years of his life in establishing a business whose substantial success was almost entirely due to his restless energy and executive ability.

In the lull of the panic of 1893, Mr. Sevigne, for twenty-five years the superintendent of the works, resigned, and the management fell upon Mr. E. T. Gilbert, who first came to the company as secretary, in 1879. In 1895, their capital stock was increased to \$200,000. In the winter and spring of 1895-6 a new factory was built on the south side of Wight St., taking the place of all the old structures and additions, and measuring 55 feet by 555 feet, of brick, with steel trussed roof, about half the building being two stories high, wherein were the offices, facing the beautiful Detroit River, and the packing, shipping, pointing and cutting rooms, and the machine shop, giving in its completed form one of the most convenient and well-arranged factories in the West. In recent months the company has purchased a large strip of land lying directly west of their factory, and about three times as large as their present acreage, which will give them a chance to enlarge their greatly overstrained quarters, and furnish one of the best docks in the city, having a total frontage on the river of 330 feet.

The present officers of the company are: E. Y. Swift, president; E. T. Gilbert, vice-president and treasurer; F. S. Bigler, secretary.

MISSOURI.

THE KANSAS CITY BOLT AND NUT COMPANY. *Kansas City.*

The Kansas City Bolt & Nut Company was established and equipped in 1887, and incorporated April 6, 1888, with James H. Sternbergh, president; P. H. Sternbergh, vice-president and treasurer; H. R. Warren, secretary, and Solomon Stoddard, assistant manager. It was capitalized at \$200,000. The company was the offspring of the extensive manufacturing company of J. H. Sternbergh & Son, of Reading, Pa. The company has been ably managed and highly successful at all times, and ranks as one of the most enterprising and progressive manufacturing establishments in the State of Missouri. It supplies to an extensive and steadily increasing market, all of the various styles and sizes of standard bolts and nuts known to the trade.

The present officers are: J. H. Sternbergh, president, Reading, Pa.; H. M. Sternbergh, vice-president, Reading, Pa.; H. R. Warren, secretary and treasurer, Kansas City; Solomon Stoddard, manager, Kansas City.

ST. LOUIS BOLT AND NUT FACTORY. *St. Louis.*

The bolt and nut industry was first introduced in St. Louis in 1856, when Richard H. Cole invented and patented a hot-pressed nut machine. Soon after, the St. Louis Bolt and Nut Company was organized and purchased Mr. Cole's apparently valuable patent rights. The venture did not prove successful, and a number of changes occurred, involving suspensions and revivals at intervals, long and short, until the

St. Louis Bolt Co., better known, perhaps, as the Tudor Iron Co., was organized during the 80's, which nurtured the spark of life for a few years, when it was absorbed in turn by the prosperous Republic Iron and Steel Co.

THE MORAN BOLT AND NUT MANUFACTURING COMPANY.

St. Louis.

A highly successful pioneer of the bolt and nut business in Missouri was William Moran, of New York City, who had learned to operate an Oliver while working in the horseshoe-nail shop of his father, James Moran, who used the Oliver in drawing nails to the desired length.

Early in the 60's young Moran occupied a small building in St. Louis, where he installed an Oliver and began making carriage bolts for the trade. Unlike many other ventures of the kind, his business prospered from the very beginning and continually improved, requiring increased machinery and facilities which were promptly provided. In the course of time the factory was removed to spacious quarters at the corner of Main and Florida Streets, where it is now known as The Moran Bolt & Nut Manufacturing Co., and is recognized as among the leading establishments of the kind. It is capitalized at \$150,000. The factory is admirably equipped with the most modern machinery and other appointments. The chief products of the factory are the heavier grades of bolts and nuts.

KENTUCKY.

LOUISVILLE BOLT & NUT COMPANY.

Louisville.

In 1895 Mr. Lyman S. Taylor, formerly of Southington, Conn., who had been connected with The Anderson (Ind.) Bolt & Nut Company, conferred with parties in that city with reference to organizing a new bolt factory and, about a year later, he succeeded in forming what was known as The Anderson Iron & Bolt Co., which was principally owned and managed by John R. Brunt. Soon after organizing, this company purchased most of the machinery of the old Coleman (Covington, Ky.) Bolt Works, and shipped it to Anderson. In transit, however, a railroad accident occurred and the machinery was so greatly damaged that very little of it was worth repairing. Other equipment was provided, however, and the company continued in Anderson until 1899, when the entire works were removed to Louisville, Ky., and the Louisville Bolt & Iron Co. was organized. Large additions were made to the equipment, consisting of the latest improved machinery, and two rolling mills were also connected with the plant. The company manufactures carriage, machine, bridge and roof bolts, lag and coach screws, etc. The entire works were destroyed by fire in the spring of 1901. A large portion of the machinery that was preserved was taken to New Albany, Ind., where it was repaired and installed in new buildings erected in Louisville in the meantime. Mr. Taylor, who promoted the enterprise and served as general manager and leading mechanical expert of the company, died March, 1903.

The present company is incorporated and managed by the following officers: F. W. Bonnie, president and treasurer; C. L. Robinson, vice-president; Frank W. Bonnie, Jr., secretary; Chas. Schunk, superintendent.

CALIFORNIA.

PAYNE BOLT WORKS. San Francisco.

The Payne Bolt Works, originally known as The California Bolt & Nut Works, was established in 1871 by William and John Payne, practical bolt and nut makers, who were born in England, where they had mastered their trade. The business was started with a very small capital and the equipment of the factory was limited to one English Oliver, run by foot power, and such other tools as were indispensable. The principal product was hexagon nuts of an extra thickness, made for the Southern Pacific Railroad Co.

When cold pressed nuts were placed on the California market this branch of trade proved so unprofitable to the company that the bolt business was made a specialty. In 1875 George L. Payne, a younger brother, who had just finished his apprenticeship as a bolt and nut maker, came from England and joined his brothers. In 1877, declining health induced John Payne to sell his interest to his brother William, who conducted the business successfully until 1881, when Geo. L. Payne became a member of the firm and the style was changed to Payne Brothers. The first bolt heading machine was purchased in 1880. In 1882 another bolt header was purchased, together with a cold staving or upsetting machine and two power Olivers for heading staves or upsets into full square carriage bolts, this being the first introduction of the manufacture of carriage bolts on the Pacific Coast. In 1888 a new factory, costing \$50,000, was erected and new machinery and appliances added to the outfit, including another heading machine.

On December 17, 1888, the business was incorporated under the name of Payne's Bolt Works, but the individual

interests remained unchanged. William Payne died in 1892, leaving George L. Payne, the present president of the company, general manager, a position that he still occupies and one that he has filled with conspicuous ability. This prosperous company was the first to introduce the manufacture of carriage bolts, and at the present time the oldest manufacturer in existence on the Pacific Coast. From a humble beginning it has steadily progressed until it holds a distinguished position among the most prosperous establishments of the kind in the Western world.

COLORADO.

THE COLORADO FUEL & IRON COMPANY. Pueblo.

The Colorado Fuel & Iron Co. established a thoroughly equipped bolt and nut department at Pueblo, Colo., in 1890, under the management of Mr. T. H. Haley. It is styled "The Bolt and Nut Mill," and is merely an adjunct to the other industries owned by the company. The product of the bolt and nut department is almost entirely used by the other branches of their enterprise and especially by The Atchison, Topeka & Santa Fe Railroad, which is one of them.

The following from a correspondent of the Newspaper Press Association is appropriate to this history, as it graphically describes the manner in which business is done in the monopoly-ridden city of Pueblo:

"Watch our smoke" is the motto of Pueblo. It is sufficiently appropriate, for that is the thing most easy to watch. Black, impenetrable, a vast plume it pours from the cluster of stacks to the south of the city, and envelops the whole in a spreading pall.

But in Pueblo no one thinks about smoke as a nuisance. To these people it stands as the symbol of the great iron industry, the greatest and almost the only plant of the sort in the far West. Out in the arid desert, watered by irrigation alone, the smoke of Pueblo means the development of native resources, and commercial independence of the East.

Pueblo is the Pittsburgh of the far West. It is grimy, dusty, and useful. Its one great plant makes steel rails, wire, bolts, nuts and everything needed for commercial and railroad purposes. It uses the coal of the State, and the iron taken from Colorado mines, and most of the output of the mills is marketed west of Kansas City. The plant is valued at \$30,000,000, and the proprietors are just investing \$15,000,000 more in additional facilities. The commercial west is proud of Pueblo.

The Rockefellers and Goulds have just bought these steel mills. They say they want them as an adjunct to their railroad enterprises. The mills are not in the trust, and they help to keep down prices.

The city of Pueblo is incidental to the mills. It is a city set down in the middle of a vast, cheerless desert. It never rains here, or not enough to mention. But the Arkansas river flows by, and from it water is taken in ditches and pipes and put upon the land. Everything that is grown depends upon artificial watering. Sometimes the river runs so low that the mills are hard put to it to get all the water they need, and to provide against this contingency they have built a large artificial lake where water is stored for their own particular use.

The city claims a population of 60,000, although the last Federal census gives it less.

The Pueblo mills are technically known as the "C. F. & I." Here everybody knows that those letters mean the Colorado Fuel & Iron Co. The C. F. & I. dominates everything. It owns the railroads, the irrigation water, the mines of iron

and coal near by, and about all the best real estate in the city. Under its wing is run a large system of "company stores," something like those which have been the curse of the Pennsylvania coal fields, and the 7,000 employes of the Pueblo mills are kept poor by the system.

The men are kept in debt to the company, which continues to give them credit so long as they are employed in the mills. But one variation of the company store system has been discovered and put into operation here, which adds to the fat dividends of the proprietors and it is said violates the Federal laws. This is the practice which prevails of issuing scrip which the men may use in lieu of money to make purchases at the stores. The men take the scrip for wages and discount it for 85 cents on a dollar to the people of the city. It is said that the company feels strong enough to defy the Federal law which would tax such scrip 10 per cent., and the State law, which prohibits it entirely.

MARYLAND.

MARYLAND BOLT & NUT COMPANY. Baltimore.

In 1892 The Maryland Bolt & Nut Co., Curtiss Bay, Baltimore, was organized from the South Baltimore Car Company's works by C. A. Hotchkiss and Percy Donaldson. With the exception of one Lewis heading machine, the machinery was all bought new, from the National Machine Co. of Tiffin, O. The outfit included four Lewis, four Chapin and two Burdick heading machines, and the factory was fairly equipped throughout. They manufactured various lines of bolts, chiefly for the Baltimore & Ohio Railroad Company,

which had an interest in the car works. After remaining in business four years the works were transferred to the National Supply Company, by which the business is still continued.

WISCONSIN.

THE NATIONAL ELASTIC NUT COMPANY.

Milwaukee.

The National Elastic Nut Company of Milwaukee, Wis., makes a specialty of the elastic self locking nut, a clever invention, that has proved very popular in the general market. Instead of being punched from a solid bar, this nut is formed by bending a flat bar into a ring and then pressing the ring into the form of a nut. The ends join with a lap, and the completed nut, when used, acts as a spring, having elasticity and hugging the bolt so closely as to lock it at any desired point. The offices and works are at the corner of Russell and Superior Streets, Milwaukee, and the officers are C. F. Ilsley, president; John Campbell, secretary and treasurer, and T. L. Paine, manager.

SOUTH CAROLINA.

CHARLESTON BOLT WORKS.

Charleston.

In 1854 Messrs. Charles Miller, Thomas Chamberlain and John Foster, of Philadelphia, Pa., conceived the idea that the "Sunny South" would afford a prosperous field for the bolt and nut industry. Accordingly they formed a co-part-

nership under the title of The Charleston Bolt Works and established a well equipped factory in Charleston, S. C. With what they deemed rare sagacity, the projectors of the enterprise had counted largely on the advantages of cheap labor in the South, a commodity that they soon found was extremely plentiful, but far from profitable. The slave owners stood ready to furnish any number of lazy, shiftless and incompetent negro laborers at almost any price, but it was found impossible to utilize such labor to any extent, and especially, as the skilled, white laborers, capable of performing mechanical labor utterly refused to work in a factory where colored labor was employed. Beside this, the consumers entered a protest against goods produced under such a condition of affairs, and as a result their product found it difficult to find a market in any direction. This state of affairs was of short duration. During the troublous times that preceded the Rebellion, the enterprise vanished, so to speak, into thin air, the projectors hied themselves northward, and left their plant and machinery to be divided among the "Southern gentlemen," to whom they were heavily indebted for cheap labor and other commodities. Thus ended the pioneer bolt and nut enterprise south of Mason and Dixon's line.

WEST VIRGINIA.

THE WHEELING HINGE COMPANY *Wheeling.*

Farmer Brothers began manufacturing carriage bolts on Market Street, West Philadelphia, in 1847. They removed their works to Newark, N. J., in 1859, where they took as a partner, H. D. Smith, a carriage hardware manufacturer, of Plantsville, Conn. Mr. Smith withdrew from the firm in

1865, at which time the business was closed and they removed to Wheeling, W. Va., where they added the manufacture of harrow teeth to their product. They continued in business until 1866, when they sold their machinery to the parties who afterwards organized The Wheeling Hinge Co. This company manufactured bolts and nuts of various kinds until about 1900, when they entirely abandoned this branch of their business, a few years later reorganizing under the title of The Hazel Atlas Glass Company, successors to the Wheeling Hinge Company. C. N. Brady, President; W. S. Brady, Vice President; I. C. Brady, Secretary; G. M. Ford, Superintendent.

BOLT AND NUT MAKING IN THE SOUTH.

AMERICAN BOLT COMPANY.

Birmingham, Ala.

Accessible data concerning the bolt and nut industry in the Southern States is so meager that it is impossible to give a satisfactory history of the many Southern ventures that were born to die during their infancy, or of the very few that survived the infantile diseases, only to embrace their fate during the period of adolescence.

Undoubtedly the principal cause of so many failures in the South was the reliance placed on the profit anticipated from "cheap labor." Manual labor was a prime factor to be considered, and as cheap labor was a drug on the Southern market, it was generally argued by the projectors of bolt and nut enterprises, that the saving made in this direction would readily overcome all other obstacles to success. It was not until this important point was tested that the awakening came, and it seldom came in time to avert calamity. Cheap labor, rendered by indolent darkies and "poor white trash," was plentiful, but it was utterly useless, except in minor ways, and

could be made of no value at all, unless expensive workmen from the northern factories were employed to perform the technical work required. Northern experts could not be induced to accept service in Southern factories, except at high salaries, and their services could not be dispensed with. As the extra cost for expert workmen by far exceeded the saving made on cheap labor, the whole matter of profit in this direction came to naught. It is hardly necessary to mention the many other causes that shared in hindering the success of these Southern ventures — such as a lack of experience, slow business methods and their inability to find a market that was not pretty fully occupied by their enterprising and wide-awake Northern competitors.

Birmingham, Ala., with its splendid natural advantages, presented an attractive opening for the bolt and nut business, which was first occupied by a company in 1878. Although the business never proved successful, it was continued until 1896, changing hands resulting in the organization of at least four distinct companies in the meantime, each of which failed in turn. Those factories were closed, reopened and operated at intervals. During this year renewed activity in the business was awakened. The old bolt and nut works on Fifteenth Street and Powell Avenue, equipped with a Lewis and a Chapin heading machine, Carter nut presses and a number of bolt and nut finishing and other machines, including a large bridge rod upsetting machine, was put in operation, employing electricity as a motive power and adding various modern improvements. This company also controlled the patent on an elastic nut that promised to be very valuable, and which they had prepared to manufacture on an extensive scale. To all appearances they were justified in anticipating a prosperous future, but they had hardly got fully under way, when a disastrous fire occurred, in July, which rendered the entire plant a total ruin and caused a speedy and final abandonment of the undertaking.

An entire new company now entered the field. Messrs. Colwell and Lock erected a fine sheet iron, one-story building, 50 x 200 feet, supplied with steam power, at the corner of Fourteenth Street and Powell Avenue, which was equipped by The National Machine Company, of Tiffin, Ohio, with one Burdick, one Lewis and one Chapin heading machine, one Dunham forge nut machine and one Sternbergh hot-pressed nut machine. A second-hand Lewis and Chapin heading machine was afterwards added to the outfit, and in connection with these they ran 22 cutting lathe heads. Strange as it may appear, their daily output was only about 13,000, chiefly plow and carriage bolts. The manufacture of plow bolts was soon abandoned and square head machine bolts substituted in their stead. The machines in the forging departments were run by Northern mechanics, who were paid "Northern" prices, and those in the finishing department were operated by Southern white women, who, of course, received "Southern" prices for their services. It is said that the finishing of their work was extremely faulty, a statement that can hardly be doubted. Soft coal was used for the boilers and crushed coke for the bolt and nut furnaces.

In a letter to a Northern friend, describing the bountiful facilities of the factory, the superintendent, Samuel Bardolph, said: "Ther's good furnaces, plenty-er coke and lots-er heat." The building had lifting doors on each side, which, when raised gave it the appearance of a circus tent, but provided abundant fresh air, which was greatly needed in the exceedingly hot climate.

There was hardly a woman in the corps of finishers that was not grossly addicted to dipping or chewing snuff, and many of their facial contortions while dropping the lower lip and tucking their dipping sticks or a wad of snuff in their mouths was painfully disgusting.

The common labor was performed by colored men, who profited by the "protection" given to American labor, by

earning the princely salary of sixty-five cents per day. These typical Southern darkies furnished a great deal of amusement for the Northern workmen. Good natured, light-hearted and sportful as monkeys, they sang and chattered while at work and were comical at all times. On cool days they wore common coffee sacks, with holes cut in them for their arms, and a bunch of coons in this apparel had the appearance of animated coffee sacks, provided with legs, arms and woolly heads. Of course, the service rendered by such uncouth creatures was about equivalent to the emolument they received. One old darkey, who received a fixed salary of \$20 per month for cutting iron, was asked why he did not strike, and demand a dollar per day. "Why," said he, "anudder nigger; he like de job; den what's poor old Joe gwine to do?"

The effects of the enervating climate and the shiftless surroundings were depressing to the Northern operatives and no doubt rendered them careless and inefficient to a degree. A sort of a wag, called "Hungry," because he was accused of having the "fever delurk," with two stomachs to eat and none to work, became so seriously afflicted by the prevalent lethargy that he idled away most of his time in playing practical jokes on his fellows and especially on a drowsy old darkey, employed to fire the boilers, who frequently fell asleep during his watch and was seldom, if ever, fully awake. "Hungry" delighted in sneaking into the boiler room, and giving the whistle a blast and escaping without being detected, whenever he discovered the old coon sleeping. The first time that he played this prank, the superintendent rushed into the engine room and found the old darkey rubbing his eyes and about half awake.

"What in h—l is the matter, here, nigger?" shouted the superintendent. "De lawd knows, massa," said the coon. "I guess der must been a cow on de track."

During the declining days of its existence the company attempted to economize by using coke oven-screenings for

fuel, a plan that disgusted the Northern employes and especially aroused the indignation of "Hungry," who absolutely rebelled against trying to do good work with such material. One day he saw a car load of merchantable coke standing on the track and he ran out and communed with it, standing by its side and soliloquizing for fully half an hour. Then he gathered a few lumps which he took to the factory to exhibit among his fellow workmen as remarkable specimens.

These incidents are illustrative of the impractical manner in which the bolt and nut factories of the Sunny South were quite generally managed, and possibly they afford a sufficient idea of the condition that induced the one in question to wind up its affairs in less than two years.

A firm under the title of The Southern Bolt & Nut Co., managed by W. H. Merritt, bought the plant and machinery and resumed the business. After struggling a few years Northern capital came to the rescue in 1903 and a consolidation was effected with the American Bolt Company of Lowell, Mass., whose works were removed to their present plant on Thirty-ninth Street, East Birmingham. The officers are: W. H. Merritt, president and general manager; John J. Wirth, secretary and treasurer; Percy Parker, first vice-president; Charles H. Merritt, second vice-president; H. C. Brill, secretary.

THE VULCAN IRON WORKS.

(Bruce & Archer)

Richmond, Va.

The Vulcan Iron Works, Bruce & Archer, was the title of a bolt and nut concern that apparently did a very prosperous business during the eighties, and seemed to have reached the zenith of success in 1887, when it quietly retired from business entirely.



Yours truly
John Stephens

SAVANNAH, GA.

A bolt and nut factory was started in Savannah, Ga., in 1868, which used the Philadelphia Oliver system. It continued in business several years apparently at a standstill and finally folded its tent like the Arab, and disappeared, leaving no trace behind.

ROANOKE, VA.

An attempt was made to start a factory in Roanoke, Va., during the eighties, but the concern failed before getting fairly in operation.

CANADA.**JOHN STEPHENS.**

Mr. John Stephens was born in Toronto, Canada, December 11, 1850. After finishing his course in the public schools, young Stephens entered the Model School of Toronto, from whence he graduated at the age of sixteen years. Having a natural taste for mechanical arts, he secured employment in the works of Chas. Levey & Co., where he thoroughly mastered the machinist's trade.

In 1871 Mr. Stephens accepted a position with the Canada Bolt & Nut Co. of Toronto, which he held with promotion to superintendent during the various fortunes of that and several succeeding companies.

During 1890 to 1895 Mr. Stephens supervised the building of the machinery and managed the mechanical affairs of the factory of George Gillis at Gananoque, Canada, the ma-

chinery of which was removed to Toronto in 1895 and merged into the Toronto Bolt & Forging Company, of which Mr. Stephens was made general superintendent.

Probably no other mechanic in British America has had a more varied experience than Mr. Stephens in dealing with the fluctuating fortunes of the several companies with which he has been connected. During all of the vicissitudes of the Canadian enterprises, however, his services were always in demand, and it was measurably due to his mechanical skill and ingenuity that many perplexing problems were successfully solved. During his long connection with the bolt and nut business he has witnessed the rise and fall of a number of promising enterprises, but always shrewdly, and perhaps, luckily, escaped being involved in the financial calamities.

Mr. Stephens is a patriotic son of Canada. He believes in his mother country, and has unbounded faith in her institutions. In politics he is a conservative and a loyal subject of the crown. Socially he is a true exponent of goodfellowship, a royal entertainer and a man for all companies. He is a prominent member of the Masonic fraternity and is one of the most widely known and popular citizens of Toronto.

THE BOLT AND NUT BUSINESS IN CANADA.

The first bolt and nut factory in Canada was established in 1850 at Gananoque, and was the offspring of the abandoned business of Theodore D. F. Read, of Mt. Carmel, Conn., from whence the machinery and equipment were removed. The factory was managed by a foreman, employed by Mr. Read, and did a fairly prosperous business until the close of the United States War of the Rebellion, when complications arose which resulted in a failure, and the factory was permanently closed.

CANADIAN BOLT COMPANY.**Perth and Toronto.**

The bolt and nut industry was first permanently established in Canada by the Canadian Bolt Co., incorporated with a capital stock of \$100,000, December 5, 1868, and located at Perth, with Sir Hugh Allan, president and principal stockholder; W. J. Morris, manager, and Amos B. Simons, superintendent. Mr. Simons had been formerly connected with the Plant Manufacturing Co. of Plantsville, Conn. He was a thorough mechanic and an experienced bolt and nut maker, and he had entire charge of installing the machines, including the Chapin heading and Dunham nut forging machines in the new factory. The latter machines were built in Canada, and for a number of years were known as the "Simons forged nut machines."

On March 2, 1872, the entire works were removed from Perth and installed in new factory buildings at the corner of Front and Sherbourne Streets, near the Esplanade, in Toronto, where, after a few years of unsatisfactory business, the works were closed.

THE DOMINION BOLT & IRON COMPANY.**Toronto.**

In August, 1879, the entire plant and business were sold to Mr. John Livingston, who made extensive additions and improvements and conducted the business under the title of The Dominion Bolt Works, John Livingston, sole proprietor. Mr. Livingston established his main business office in Montreal and employed Mr. Robert Miller as general superintendent of the factory. Expert bolt and nut makers from the United States were employed and a number of the latest improved automatic and other machines were purchased and put in successful operation; and in the following year, 1880,

the name of the concern was changed to The Dominion Bolt & Nut Company. The company manufactured a full line of bolts and nuts, including fancy varieties, also tire and stove bolts, rivets, bridge rods and railroad spikes. Soon after, a large tract of land was purchased at "The Humber," Swansea, a few miles west of Toronto, where commodious factory buildings were erected, to which the entire city plant was removed and new machinery added, in September, 1882. It was said that Mr. Livingston was ambitious to create an important manufacturing town or city, patterned after the manufacturing center at Pullman, Ill., when he contracted for the Humber real estate. Howbeit the idea was abandoned, for, in the fall of the same year, a joint stock company was organized with a capital of \$500,000, under the title of The Dominion Bolt & Iron Company, with Mr. Livingston as general manager. After a very brief existence this company failed and the works were closed.

ONTARIO BOLT & IRON COMPANY.

Toronto.

In December, 1885, The Ontario Bolt & Iron Company was incorporated with an authorized capital stock of \$120,000. James Worthington was made president and this company purchased the machinery and other assets of The Dominion Bolt & Iron Company, making various improvements and adding a rolling mill to the plant.

TORONTO BOLT & FORGING COMPANY.

Toronto.

Six years later, in 1891, the company was organized as The Ontario Bolt & Forge Company, and the stock was in-

creased to \$200,000, the same management remaining in charge of its affairs. This company continued business until September, 1894, when it went into liquidation.

On July 26, 1895, The Swansea Forging Company was incorporated with an authorized capital of \$100,000. This company, in turn, purchased the plant of the former company and began business with George Gillies as president and manager. At the expiration of four years another change occurred in the affairs of the habitually changeable company, and on August 8, 1900, The Toronto Bolt & Forging Company (Limited), capitalized at \$500,000, absorbed the entire business and also the plant of the George Gillies Company, at Gananoque, Ontario. The officers of the company were George Gillies, president; T. H. Watson, secretary and treasurer, and John Stephens, superintendent. Under the management of this company the business has steadily prospered and increased in volume, and the facilities of the plant have been proportionally increased by the addition of modern machinery and appliances to meet the increasing demands on its resources. At the present writing The Toronto Bolt & Forging Company stands among the foremost of the great manufacturing industries of Canada. The present officers are George Gillies, president, and T. H. Watson, secretary and treasurer.

THE PILLOW & HERSEY MANUFACTURING CO. Montreal.

The Pillow & Hersey Co. of Montreal, one of the larger and most successful industrial establishments in Canada, added to their rolling mills, cut nail, spike and horseshoe works on St. Patrick Street, a large and perfectly equipped bolt and nut department in 1879. Mr. Daniel Coe, an experienced bolt and nut maker from Winsted, Conn., was placed in charge of the factory, which was furnished through-

out with the latest improved American machinery, admirably arranged. In addition to their prime specialty, the "Rhode Island" horseshoe, on which they controlled the Canadian market, this enterprising company extensively manufactured bolts, nuts, rivets, nails, spikes and the various sizes and grades of merchantable bar iron.

In 1888 this company was succeeded by The Pillow-Hersey Manufacturing Company (Limited), with an authorized capital of \$800,000. Until his death, which occurred in 1902, Mr. John A. Pillow served as president of the company. In the following year, Mr. Pillow's interest, amounting to \$315,000, was sold to The Montreal Rolling Mill Company, which thus obtained the controlling interest. The following officers were elected: J. Randolph Hersey, president; E. N. Heney, vice-president; directors, Charles P. Hosmer, Milton L. Hersey, and L. B. Pillow.

After the death of Mr. John A. Pillow, and until his interest was transferred, Mr. W. W. Near practically had charge of the business, and to his business sagacity, foresight and earnest application are credited a goodly share of its uniform success. Mr. Near retired in 1903. He was succeeded by Mr. William McMaster, manager of the Rolling Mill Company.

ROBERT LILLIE.
Perth.

Mr. Robert Lillie embarked in the business at an early day, establishing a small factory in connection with his machine shop at Perth. He struggled manfully for several years to stem the tide of opposing fate and unfavorable conditions, abandoning the bolt business and resuming it at intervals, but with such unsatisfactory results that he finally disposed of his bolt machinery and contented himself with the legitimate business of his machine shop.

CURREY & MILNE.**Smith Falls.**

Currey & Milne, of Smith Falls, opened a factory in 1883, and continued in business nearly nine years, when reverses forced their final suspension.

PARMENTER & BULLOCK COMPANY.**Gananoque.**

The Parmenter & Bullock Company, of Gananoque, was established in 1870 by C. L. Parmenter and William Bullock. Mr. Parmenter died in 1889, and Mr. Bullock continued the business until 1896, when the company was incorporated under the present title with a capital of \$100,000. Their principal output is rivets and small bolts, for which they have secured a profitable market. The officers are: William Bullock, president; P. P. McMurtry, vice-president; W. B. Bullock, superintendent, and J. A. Bullock, secretary and treasurer.

BROWN & COMPANY.**Paris.**

Brown & Co., David Brown and John Allen, proprietors, of Paris, Ontario, began business in 1872, and seem to have escaped the fate that met so many of their contemporaries, for they are still doing a very prosperous business.

THE LONDON BOLT & HINGE COMPANY.**London.**

The London Bolt & Hinge Company, London, Ontario, is chiefly owned and managed by John White, who has built up a very prosperous and increasing business.

THE BRANTFORD SCREW COMPANY.**Brantford.**

The Brantford Screw Company, Brantford, Ont., was established in 1898, by Fred and Edwin Chalcraft, as the Chalcraft Screw Co. In 1902 the company was incorporated under the present title, with a capital of \$150,000. The officers are: Lloyd Harris, president; E. L. Goold, vice-president; A. P. Goering, superintendent.

IN GENERAL.

We find dim records of a number of short-lived bolt and nut ventures in the Dominion that seem to have "put forth the tender leaves of hope" with no end in view, except to meet "a killing frost."

One of the temporarily successful of the bolt and nut manufacturers in Canada was a college-bred man of ample fortune, who was induced to embark in the business as an experiment. Although a ripe scholar and well informed on all general subjects, he had so little knowledge of practical mechanism that he invariably amused his foreman and the expert mechanics in his employ whenever he attempted to solve purely mechanical problems. For example, while showing a friend through his factory one day, they stopped to watch the operations of a machine that was making what was known to the trade as "skew-head" bolts, on which the head is forged at an angle for the purpose of fitting special thill connections. In examining one of the bolts, his friend remarked that the head seemed to be a "misfit." "There

must be something wrong about a machine that turns out such an awkward bolt as that," suggested his friend. "Certainly," said the proprietor, and taking one of the bolts, he rushed excitedly to the foreman and demanded an explanation. "Why, the bolt head isn't true," said he, "look at it. Why it is set on an angle of about forty-five degrees. The machine must be out of order." The matter was promptly explained by the expert foreman, and the surprised proprietor returned to his friend, and with an air of authority explained that the bolt was all right. "We make an endless variety of bolts," said he, "and this happens to be a special pattern that I had not seen before."

By advice of his foreman, who was master of his business, this college-bred manufacturer had been induced to purchase an English iron, known as "Lowmoor iron," which was cheaper but quite as good for making bolts and nuts as the Norway and Swedish iron, used by the manufacturers in the United States. Owing to the carelessness of the manufacturers of this grade of iron, however, it was never of a uniform size or shape, and the "Yankee workmen" in the factory classed it as "accommodation iron" because they said they could make either bolts or nuts from the same bundle. In order to abate this evil the college man was very exacting in wording his orders for supplies. "I firmly insist," said he, "that all iron shipped to my factory must be cylindrically true and circumferentially correct." Whether or not this stern ipse dixit was understood by the iron rollers abroad, the same old "accommodation iron" reached the factory in response to future orders.

This scholarly proprietor approached his trusty foreman one day in an evident state of irritation. Handing the foreman two bolts and nuts, he said: "I am annoyed to death with complaints that our nuts are too tightly fitted. Look at

these, they have just been returned with complaints." The horny-handed foreman took the bolts and with his powerful thumb and fingers screwed on the nuts to the farthest limit and then screwed them off with the same apparent ease, and with the air of one doing nothing at all unusual or difficult. Then returning the bolts to his employer, he said: "Why those nuts move easily enough"; and so they did; for after being worked by the foreman the irate boss found that he could work them with but little effort. "Confound all such grumblers," said he, returning to his office, "I'll give them a piece of my mind. I am convinced that the majority of customers complain from mere habit, or downright meanness."

SECTION VI.

BOLTS AND BOLT MACHINERY.

THE U.S.

PATENT OFFICE

To all persons to whom these presents shall come greeting
THIS IS TO CERTIFY, That the annexed is a true copy from

The records in this office

In Testimony Thereof I, J. W. Hand
acting Commissioner of Patents,
have caused the seal of the Patent Office
to be hereunto affixed this twenty second
day of October in the year of
our Lord one thousand eight hundred and
Forty two and of the Independence
of the United States the sixty

ISSUED AUGUST 31, 1842, TO
MICAH RUGG, SOUTHBURY, CONN.

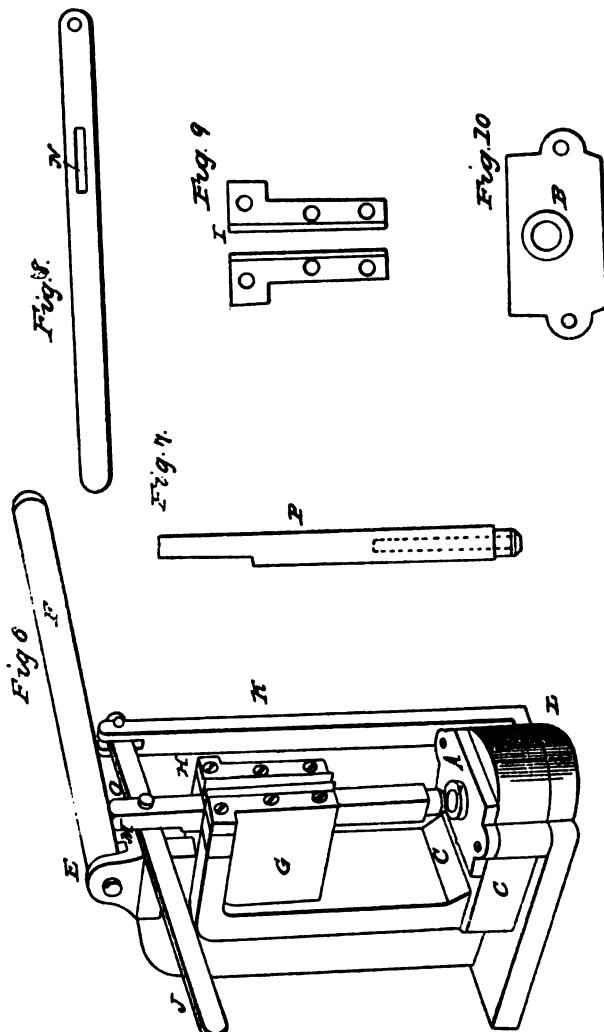
J. W. Hand

M. RUGG.

Machine for Dressing Bolt Heads.

No. 2,766.

Patented Aug. 31, 1842.

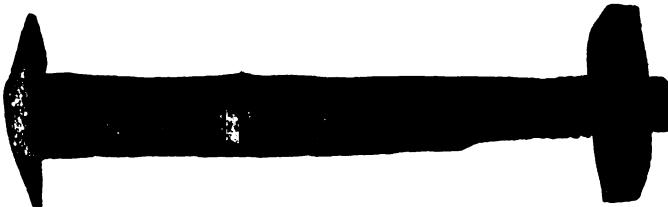


The foregoing is a facsimile of the face of a patent granted by the United States Patent Office August 31, 1842. It is the first patent ever issued in America or elsewhere on carriage bolt machinery.

It will be observed that the certification made by Acting Commissioner J. W. Hand was delayed until October 22, 1842.

The original was courteously furnished by the L. D. Frost estate, of Marion, Conn.

A facsimile of the drawings which accompanied the application on which the original patent on bolt machinery was granted to Micah Rugg is shown on preceding page.



The above is a cut of a venerable hand-made bolt, the exact age of which is not definitely known. It is of the style in use at least a century ago, after which hand-made bolts were generally fashioned until the introduction of bolt machinery in 1842. The cut is from a photograph furnished by Henry H. Clark, of Milldale, Conn.

It is extremely probable that the indispensable article known in modern mechanical parlance as a "bolt" was wholly unknown to that lusty old blacksmith, Vulcan, whose business it was to construct shields and armor for the heathen gods of the Olympian heights. He had an exact knowledge of thunderbolts, no doubt, but, in fabricating warlike implements from metal, his method of joining the various parts was entirely confined to the use of rivets, which were nothing more than short rods of iron, with "swelled heads," made to fit certain perforations of the several parts, wherein they were hammered, or riveted, and in the olden times, were wrought by hand and made as they were needed. This

primordial method of uniting separate parts of mechanical devices was also pursued by that quaint old village blacksmith, Tubal-cain, who is reputed to have pounded sparks and harmonious music from his melodious anvil, at one and the same time. The introduction of the screw-thread, which brought the bolt and nut into being and caused them to so largely supersede the rivet and washer, contributed little or nothing towards improving the process by which they were constructed. For thousands of years they were made by hand, as the rivet and washer had been for thousands of years previous.

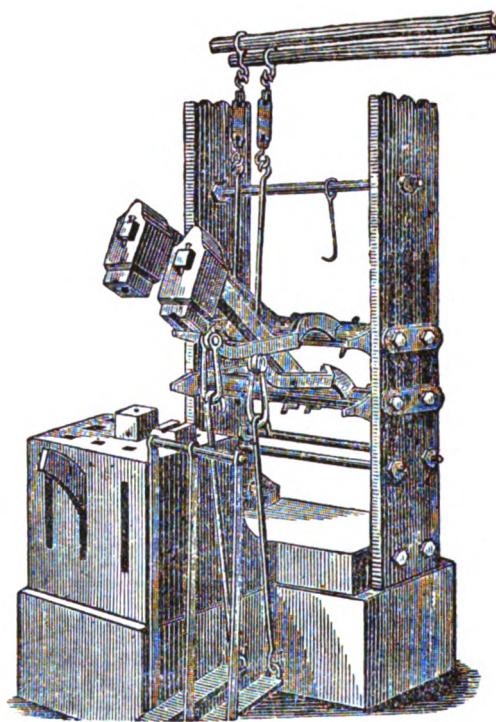
The early history of the bolt and the nut, however, is extremely meager, clouded, obscure and unsatisfactory. The bolt is described as "a stout metallic pin, employed for holding objects together, screw-threaded at one end to receive a nut." The nut is described as "a small plate of metal pierced and threaded to fit a bolt." When the first bolt and nut was fabricated, history fails to record. Although improbable, it is not impossible that they were wrought by the Olympian blacksmith or by the smiths employed by the old Rameses; but as to this, history is blank. Enough has been gleaned from various sources, however, to prove that they were of very ancient origin, and that they were manufactured by hand in the same old bungling way for thousands of years, and that it was not until the nineteenth century that any considerable progress was made in the mode of their construction, although a few minor steps in advance were made during the sixteenth, seventeenth and the eighteenth centuries.

The earliest screw threads were cut with a file; a tedious process, to be sure, but one that produced most satisfactory results at the period. In the course of time this process was superseded by an improvement that consisted of filing the teeth or threads into a thin, flat piece of steel fastened into a suitable handle. The bolt, or that which was to be screw-threaded, was made to revolve by foot power in a lathe and

the thread cut by passing the tool over the work a number of times. It was called chasing or combing the thread, and the tool, chaser or comb. This was the original application of machinery to the making of bolts and screws, and it was first made by Besson in France in 1568, who afterwards contrived a screw-cutting gauge or plate to be used on lathes. This device was further improved by Hindley of York, England, and for many years was in general use.

The bolt heading machine is said to have originated in Germany, but we are unable to find authority to substantiate the claim. Royal patents in England were granted to John and William Wyatt bearing date of May 14, 1760, for three machines designed to make wood screws, one for heading blanks, the other for slotting or nicking the screw heads and the third for cutting screw threads. This was undoubtedly the Philadelphia "little engine." The principles involved in these machines have been improved upon from time to time until they have developed into our modern heading and screw cutting machines that head machine, tire, carriage and stove bolt blanks automatically from the coil at the rate of 100 or more per minute, at an average of 25,000 or more per day; screw cutting machines that actually pick up the bolt blanks from the hopper, convey them to and clamp them in a holder, point and cut on them a finished thread and throw them into a box automatically.

Thomas Oliver, of Darlaston, Staffordshire, England, invented the first bolt forging machine about 1830. This has always been known as the "English Oliver." It was originally worked with back treadles, so that the boy who worked the bellows could jump on the treadle, behind the operator and add his weight to the work of operating the machine. A wooden post, with a ring was arranged for the boy to hold on while assisting. The English Oliver occupies a conspicuous place in the history of bolt and nut making and contributed largely to the tide of improvement.



THE ENGLISH OLIVER.

IMPORTED BY WILLIAM GOLCHER, 1840.

In 1838 Micah Rugg, the pioneer bolt maker, invented the first treadle heading block, following it in 1839 with his treadle heading vise, and in 1842 he brought out his bolt head trimming machine, on which he secured a patent on August 31, 1842. Later this method of treating bolt heads was developed into what was known as the "old hammer lathe," and eventually became the spring vise lathe. In 1840 Martin Barnes of the same place, and a partner of Mr. Rugg, invented a rounding press, known as the "Connecticut Rattler," and this he followed with a thread cutting lathe.

These were followed by the Kennedy crank turning lathe invented by John Kennedy of Mt. Carmel, Conn., which was originally used with a circular turning tool, afterwards replaced by the straight tool, at the works of the Lamson & Sessions in 1870. This machine was constructed with a hollow cast iron shaft, of medium length, securely held in a strongly made cast frame. The front end of the shaft carried two jaws with necessary holding dies. The rear ends of the jaws were toggled to a spindle, which extended through the hollow shaft and was connected with a lever and treadle. The toggle was forced forward with the treadle against a powerful spiral spring, closing the holding dies, which gripped the bolt while being turned, the bolt being placed in the machine with a pusher, formed like a file handle, and pressed against a light coil spring. The turning was done with a straight set tool made in the form of the head desired, held in a rocker, which was operated with the right hand by means of a crank carrying an eccentric and shoe, which elevated the rocker to a given point, very nicely turning and finishing the head. When finished the bolt was delivered automatically by reversing the crank and releasing the treadle.

The open die, spring jaw power thread cutting lathe came into use in 1853. It originated and was first used in the works of The Miller Manufacturing Company, Miller's Station, Conn.

The original lathes were built by John Curtiss, Southington Center, Conn., with two jaws connected at their back ends to a sliding sleeve by means of links. The links were tripped automatically by being forced back past their centers by the point of the bolt while being threaded, coming into contact with the front end of the gauge held in the forward end of hollow shaft and resting against a pin held fast in the movable grooved collar and passing through a slot in the shaft, similar to four-jawed cone lathes of the present day. At a later date the third jaw and cone were added, and afterwards

the fourth. Several were made with five jaws, but the fifth jaw was found to be impracticable. There is a question as to who applied the cone, several having claimed it as their invention. Mr. Barnes gives Mr. Curtiss the credit. At all events Mr. Curtiss was the first builder and no doubt he made many improvements on this important bolt machine. This machine found a place in Knight's mechanical dictionary, and is described as follows: "The bolt head enters a rectangular recess in the longitudinally sliding stock. The dies are secured to the tubular spindle of the head-stock. The forward end of the jaws are brought together by toggle levers at their rear ends. These toggle levers are pivoted to a circumferentially grooved collar, turning with the mandrel, but slid thereon by a hand lever."

It is presumed that Prof. Knight would technically term the foregoing as a "descriptive digest of scientifical, mechanical, technological vocabulary." Here is what he says of the cone thread cutting lathe:

"A machine for cutting the thread on bolts. It consists of a frame in which the revolving mandrel works. This has the dies at one end, which are operated as follows: When the machine is started the cone is shipped up so that the ends of the levers resting on it are raised. These levers being fastened, or having a fulcrum on the die plate, depresses the dies so that they may engage with the bolt to be cut; this is held between the jaws operated by the hand wheel. As soon as the bolt is cut, the cone, when pushed back, disengages the dies from the bolt so that it can be taken back without running on the thread, thus saving time and avoiding injury."

The cutting lathe was followed by the perpendicular tapping spindles, having two spindles weighted on the tops to start the taps, babbitted into a wooden frame. They were lifted by means of treadles and levers, the forked lever or lifter fulcrumed just back of the spindle with its front end or fork resting underneath an adjustable collar on the spindle

below the pulley. The spindles had but one pulley each, with a clutch pin extending up some two and a half inches above the pulley. To the spindle was fastened an adjustable collar having a like pin extending out, forming a right angle with the pin held in the pulley. The spindle moved endwise through the pulley, and when raised to its full height the pulley revolved beneath the horizontal pin, allowing the spindle to stop for removing, emptying and replacing the tap. The feed and holders were made from one solid piece of wrought iron bent in the form of a half circle, with the necessary guides and gauges. The bushings were screwed in their places.

Then came the upright revolving die tire threading machine, constructed precisely the same as the tapper, with the exception of the lower ends of the spindles and dies. The bottom end of the spindles carried a pair of jaws, cone and a stiff spring coiled around the shaft. The spring forced the cone up and closed the jaws onto the bolt. The raising of the spindle not only stopped its motion, but forced the cone down against the pressure of the spring and allowed the bolt to be removed and replaced. The dies were cylindrical, about one inch and a half in diameter by three inches long, with a bearing on either end, threaded around their entire circumferences. They were held by their bearings in a suitable horizontal bed partly immersed in soda water or oil and revolved outwards as the bolt was being threaded between them. This machine was superseded by the open jaw cutting lathe.

The next in order was the pointing lathe, consisting of a hollow shaft having a sliding spindle extending through its entire length, carrying on its front end a chuck or head with three cutters, making a cone point. It was operated from the

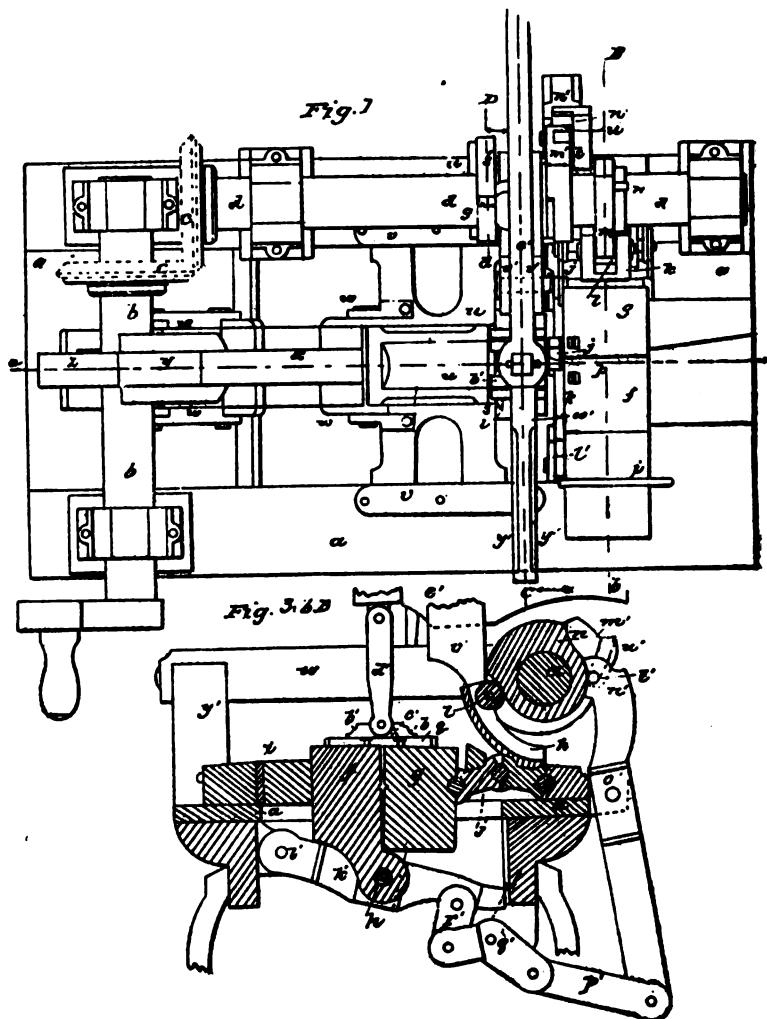
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W. E. WARD.

Making Bolts, Rivets, &c.

No. 7,538.

Patented July 30, 1850.



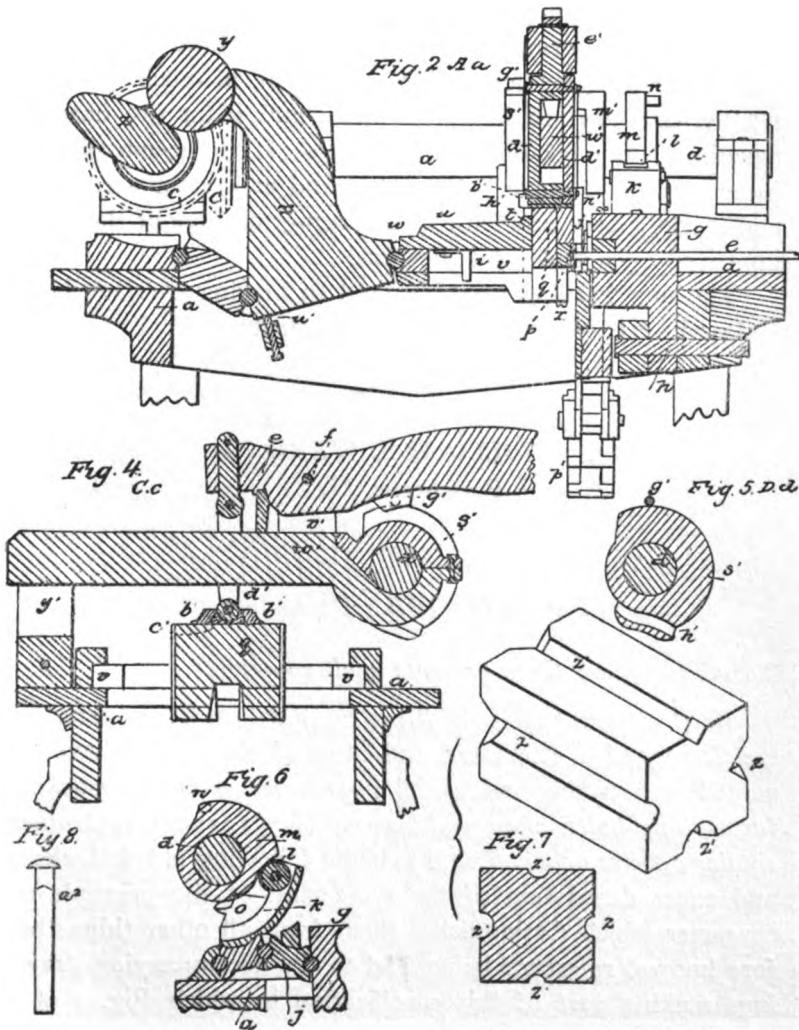
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W. E. WARD.

Making Bolts, Rivets, &c.

No 7,538.

Patented July 30, 1850.



rear end with a treadle and lever, the bolt holder being held stationary. Tire bolts and round necks were held by a perpendicular arm hinged at its bottom and closed with an eccentric lever held in the left hand.

The first power heading machine built in America, of which we find any record, was constructed at the Pierson Nail Works, Ramapo, N. Y., in 1831, for the purpose of heading wood screw blanks. In this machine the builder introduced a toggle joint slide connection, in much the same manner as described in the Coleman and Plant tire heading machines. It embodied the principles of, and eventually became a tire and stove bolt header, and at present a carriage and machine bolt automatic cold forging machine of the latest improved open and solid die type.

The first heading machine used in making carriage bolts is described in the following letters patent:

WILLIAM E. WARD.
Portchester, N. Y.

Letters Patent, No. 7538. Dated July 30, 1850.

To all to whom these presents shall come:

Be it known, that I, William E. Ward, of Portchester, in the County of Westchester, and State of New York, have invented certain new and useful improvements in the machine for making bolts, stove rods, screw blanks, rivets, and other similar articles of metal, and that the following is a full, clear, and exact description of the same, and of the principle or character which distinguishes them from all other things before known, reference being had to the accompanying drawings making part of this specification in which Fig. 1 is a

plan of the machine; Figs. 2, 3, 4 and 5, are vertical sections taken at the lines A. a, B. b, C. c, and D. d, of Fig. 1 — Fig. 6, a vertical section on the line B. b, looking in the reversed direction of Fig. 3 — Fig. 7, a perspective view and section of one of the gripping dies, and Fig. 8, a separate view of a headed bolt.

The same letters indicate like parts in all the figures.

The object of my invention, as indicated by the title, is to make bolts, stove rods, rivets, screw blanks, and other similar articles, which are formed by striking up the head on the end of a rod or wire from which the shanks are formed; but instead of first cutting off the length of wire or rod to form the shank and then striking up the head, I invert this order of procedure by first striking up the head, and then, after the shank has been liberated measuring out the length required for the shank, and cutting it off, by means of which inverted process, I am enabled to use the same gripping dies for all length of bolts, etc., having the same diameter of shank, instead of being under the necessity of having one set of dies for each length of shank.

The *nature* of the *first part* of my invention consists in gauging the length of the shank to be cut off after the head has been formed by feeding in the rod against a rest beyond the blades which has a lateral movement to permit the head to pass by it, and, by the operation of cutting off the shank, determining or gauging the length of wire which shall project beyond the dies to form the next head.

And the last part of my invention consists in cutting off the length of the shank by the return lateral motion of the header in combination with the movable rest.

In the accompanying drawings (a) represents the frame which may be varied in construction at the discretion of the constructor, and (b) the main driving shaft which receives motion from any first mover, and which by bevel cog-wheels (c. c.) communicates motion to the cam shaft (d).

The metal wire or rod (e) from which the bolts, etc., are to be made is introduced by hand or otherwise between two gripping dies of the usual construction secured in recesses (in the usual manner) in the two jaws (f. g.), both of which turn on a fulcrum pin at (h). The one (f) is the stationary jaw, and is movable merely for the purpose of adjustment by means of a wedge (i) at the back, and the other is connected with a toggle joint lever (j) by means of which the gripping and opening of the jaws is effected, one of the arms of the toggle joint having an arm (k) that carries a friction roller (b) against which the periphery of a cam (m) on the cam shaft (d) acts to effect the gripping; and after the cam has passed the jaw is opened to liberate the rod or wire by means of a pin (n), at the side of the cam, which is acted upon by the inner eccentric face (see Fig. 6) of a projecting piece (o) on the arm (k) of the toggle lever. In this way, the rod is gripped and liberated once for each rotation of the cam shaft, which cam shaft makes one revolution for each entire operation of the machine. The projection of the gripping part of the cam, its length, and position relatively to the other cams, is represented in the drawings. After the rod or wire has been gripped the heading operation takes place.

The heading die (p) is to be made with the face of any desired form depending upon the form of head intended to be produced. It is inserted in a cavity made in a heading block (q) and therein adjusted and secured by set screws (r. r.). The heading block is formed on the face opposite the die with vertical ways (s. s.) which embrace the projecting part (t) of a cross head (u) that slides on horizontal ways (v. v.) attached to the frame, and the cross head is connected with a toggle joint (w) that has its opposite bearing in the frame, one arm of the toggle having an arm (x) with a roller (y) on the end of it that is acted upon by a cam (L) on the main driving shaft (b), to force up the header to strike up the head; and when the cam has passed by in its

rotation, the header is carried back by the weight of the arm (x) and roller, until the toggle comes down to the point of a set screw (a') by which the range of motion of the header is determined and regulated, as the distance of the face of the heading die, when drawn back from the gripping dies, determines the length of the rod or wire from which the head is to be formed. So soon as the head has been formed and the header moved back, the gripping jaws open to liberate the rod or wire that it may be fed forward; but before this can be done the header must be moved out of the way. To effect this the header block is provided with horizontal ways (b'. b'.) at top which embrace and slide on a block (c') attached to links (d'. d'.) connected with a lever (e') that turns on a fulcrum pin (f'). The opposite arm of this lever is provided with a wrist pin (g'), which is acted upon by an inner face cam (h') to depress this arm of the lever to lift up the header suspended to it to a sufficient height to allow the rod to be pushed or fed forward until the head strikes an adjustable gauge (i') attached to the bottom of the header block, or the cross head connected with it, to determine the length of the shank of the bolt or other article to be made. Whilst this is in progress a rest (j'), attached to a lever (k') which turns on a fulcrum pin (l'), is elevated by means of a cam (m') that acts on the upper arm of a lever (n') that turns on a fulcrum pin (o'), the other arm of the said lever being jointed by a link (p') to a lever (q') which is in turn jointed by a link (r') to the end of the lever (k') that carries the rest.

This motion carries the surface of the rest which is grooved for that purpose up to, and under the rod or wire to act as a rest or support during the cutting operation. The header is then depressed by a cam (s') which elevates the lever (e') with which the header block is connected, and the lower edge of the heading die and the corresponding edge of the rest (j') which are made sharp for that purpose shear off the rod or wire thus cutting off the bolt or other article from the

rod or wire, leaving the required length between the face of the header and the gripping dies for the next head. The rest is then depressed by the reversed motion of the parts connected with it, the lever (n') having a pin (t) attached to it which is acted upon by an inner face cam (u') outside of the periphery of the cam that gives to this lever the motion for elevating the rest.

The connection of the header block (by means of sliding ways at right angles) with the cross-head of the toggle joint which gives the horizontal heading motion, and with the lever (e') which gives the lateral motion to remove the header that the rod or wire may be fed, and for cutting off the headed bolt, &c, admits of these motions of the header at right angles without any tendency to break or unduly strain the parts or their connections.

To facilitate the removal of the header block that the heading die may be adjusted or changed, the standards (v') which carry the fulcrum pin of the lever (e') are attached to a lever (w') that is secured by a collar (x') to the cam shaft, and its other end is secured by links (y') to the frame. When the links (y') are liberated the lever (w') can be elevated (turning on the cam shaft) and with it the lever (e') and header, thus carrying up the header so as to give free access to the heading die that it may be adjusted or taken out.

For the purpose of adjusting the heading die (vertically) relatively to the gripping dies and the rest (j'), the connection of the links (d', d') (which connect the header block with the lever (e')) are attached to a stem which passes through a mortise in the end of the lever (e') and this stem may be threaded at each end with a nut above and below the lever by the turning of which the position of the heading die can be adjusted with the greatest accuracy.

The gripping dies are made square with four faces so that they may be turned and each face adapted to different sizes of rods or wires; and the grooves (L') in each face may be

made with enlargements of any form desired, into which the metal of the rod will be upset by the header to make heads of any form desired, such as represented at a², fig. 8. The grooves at either end may be different that the dies may be reversed end for end, and thus adapt each set of dies to the making of eight different forms or sizes of articles, and each of the eight may then be used for all varieties of lengths by reason of cutting off the shank after the head has been formed as stated above.

Although I have above described the form of cams and arrangement of parts which I have essayed with success and deem the best for the practical application of the principles of my invention, I do not wish to limit myself to them, as they may be variously modified, and other well known mechanical equivalents substituted therefor.

But — *What I Claim* as my invention and desire to secure by letters patent is :

First, Gauging the length of the shank after a head has been formed on the end by pushing the head against a gauge beyond the header which has a lateral motion to allow it to pass by, substantially as described, in combination with the operation of cutting off the shank at such distance from the gripping dies as by the same operation to determine or gauge the length of rod, or wire which shall be left projecting beyond the gripping dies for forming the next head substantially as described.

And Lastly — Cutting off the rod or wire, after the head has been formed, by the return lateral motion of the header, in combination with the rest, substantially as described, the edges of the rest and heading die being formed to answer the purpose of shears, as herein described.

W.M. E. WARD.

Witnesses :

Louis F. Wadsworth,
M. G. Harrington.

THE PLANTS' HEADING MACHINE.

Plant's first heading machine, introduced in 1855, was playfully called the "Possum," because its habits strongly resembled those of that deceptive quadruped. While in repose, it had the appearance of being the most gentle and tractable piece of mechanism imaginable. When the starting lever was lowered, however, and the clutch was thrown on, the innocent appearing machine became instantly transformed into a holy terror, and it continued on the rampage until its functions were completely performed, when it would immediately relapse into its normal state of morbid quietude. It was endowed with a world of parts, levers, cams, cranks and what not, that would shame even one of our modern typesetting machines, and its design was suggestive of having been produced by a stroke of lightning. The frame bed was nearly square and on this most of the working parts were mounted. The shaft, placed above and about the middle of the bed, carried a series of cams, which raised and forced down to nearly a straight line, a toggle joint for striking the blank in forming the head on the bolt or bed screw. It was so adjusted that one or two blows could be made as required, at one revolution. The moving die was held in a cross slide and closed with a pair of knuckle-joints, operated with a cam on the end of the shaft and connected with a rod in form of a goose neck, in order to get down on a level or line with the knuckles. The machine was operated, or started and stopped, by a lever and clutch. The heated bolt blank was placed against a movable gauge and on two finger movable rests, working from under and between the dies; and the starting lever being pushed down, the machine did the rest, delivering the bolt automatically. This machine was used to some extent, but was soon superseded by another, which was provided with a driving shaft aligned with the heading dies and with a longer and narrower frame bed. The shaft carried a roll

which worked against the T-shaped rear end of the plunger slide, the front end of which held the heading die. The holding dies were closed with a cross slide, knuckle joints and cam on the end of driving shaft. The cam worked against a roller to force the knuckles forward in performing the work. This machine was operated with a clutch and hand lever, and the bolt blank was held and turned between the dies with tongs. The machine was soon improved by changing the knuckles to miter wedges, and was finally transformed into what is now known as the Smith heading machine, taking its name from Mr. Frederick Smith of Cleveland, O., who further improved the mechanism by introducing a larger ram or plunger slide which carries a double set of tools, consisting of a plunger and box die pin, which admits of the use of two sets of dies, clamped, one set above the other, by which means the bolt head is formed in the lower set of dies and finished in the upper, thus producing a finished square head bolt with one heat and two continuous operations, requiring three blows of the machine. On this combination Mr. Smith secured a patent which has proved very valuable, as a large number of the machines are in use in various parts of the country.

THE CHAPIN HEADING MACHINE.

The bolt forging machine, known as the Chapin header, had its origin in the mind of a German mechanic by the name of Adolph Frienck, at the machine works of Taylor & Whiting, Winsted, Conn., early in the fifties. In 1855 Frienck was employed by J. B. Savage of Southington, Conn., where he took the machine at Mr. Savage's expense. Both Mr. Savage and Mr. Frienck expended considerable thought, time and money in trying to perfect a machine to forge the heads on carriage bolts from square iron; but the machine proved an utter failure and was cast aside. Mr. Hermon Chapin of the

Pine Meadow Machine Company of New Hartford, Conn., by some curious circumstance stumbled upon the castaway machine, examined it carefully and became convinced that it contained valuable principles if properly applied. Utilizing his ideas, he built a machine which he sold to The Saratoga Bolt Company, under the management of Mr. Hurlburt, in the latter part of 1856. This machine consisted of a strong cast iron frame bed, shaft, balance wheel, two jaws, two wedges and slide and clapper. The bed weighed about half a ton, was a little longer than wide, and cast in a substantial manner of the best Salisbury charcoal iron. The slide was made entirely from cast iron, with wings on either side of the front end which rested on top of the frame, secured with caps and cap screws. The back part was constructed in such a manner as to pass down under the shaft and up over the rear end of the bed, making it necessary to remove the balance wheel and shaft to take out the slide. The wedges were made of solid steel, and held in position by a stud bolt screwed into their back ends and passing through the right and left wings of the slide, and fastened thereto with jam nuts. An arm or bracket extending down underneath and bolted to the bottom of the bed, held the jaws by means of pins, thereby forming movable pivot joints. The clapper was about five inches wide by seven inches long, held in the slide with clips passing over projections extending out on each side from the round. The cam, shaft and wheel were similar to those now in use. The plungers were round and of full length, the die for forming the head being turned in the ends, necessitating its removal every time it required dressing. A brass spring was coiled around it, resting between the front cap and collar, held by a set screw, on the plunger for throwing it back after striking the blow. The collar also answered to adjust the plunger for a gauge. A thin elbow or angle piece of hardened steel passed back of the jaws to receive the pressure and wear of the hardened steel wedges; otherwise, both jaws were cast iron

metal. A rope fastened to the clapper, passed up over a shieve pulley, having a tin pail tied to the other end weighted with stones or scrap iron, lifted the clapper. It was brought into contact with the cam by a treadle and double lever arrangement operated by the left foot, the lever being hinged to a bracket fastened to the slide and traveling with the same. The dies were held by the usual clamp buttons with a three-quarter inch cap screw. The machine complete weighed about 3,000 pounds. The shaft made 60 or 65 revolutions per minute.

It was considered only a partial success, very few bolts being headed by it, by reason of breakdowns; whenever the clapper caught the shaft the cast tail piece would break off from the slide, necessarily causing a large amount of lost time and expensive repairs. The attempt to operate this machine was of short duration, but long enough, however, to disclose the many defects and enable Mr. Chapin to build more successfully the second time.

As some workmen were sinking a well in the forging room, for the purpose of water supply to feed the boiler, etc., they struck a mineral spring (the now famous Geyser spring), whereupon The Saratoga Bolt Company immediately began turning the supply of valuable water to profit and abandoning the bolt business, cast aside the first Chapin heading machine, together with their other machinery, which remained idle until 1858, when they were purchased by The Plant Manufacturing Company of Plantsville, Conn., at a very low price. The Plants, dispensing with one wedge and jaw, used the machine to some extent, but finally disposed of it, through their foreman, Amos B. Simons, to The Canadian Bolt Company of Perth, Ontario, in 1868. This company failed in 1873, and the Chapin header had another period of idleness, until 1879, when it was purchased by The Dominion Bolt Company, under the management of John Livingston, and removed to Toronto, Canada. Here the machine was entirely

rebuilt, none of the original parts being utilized, except the bed and driving wheel. The Dominion Bolt & Nut Company was merged into The Toronto Bolt & Iron Company and removed to Humber, five miles west of Toronto, in 1880. This iron company also succumbed to the irony of fate and failed in 1886, and in turn was bought up by The Ontario Bolt & Iron Company, who subsequently sold out to The Swansen Drop Forge Company, now known as The Toronto Bolt & Forging Company, where the frame or bed of the first Chapin heading machine, supplied with modern working gear, is at present successfully doing business and illustrating the stability and longevity of Salisbury charcoal iron.

The second machine was built with but one wedge and one jaw. The clapper was lifted by a spring pole fastened overhead. It was bought by Mr. Dwight Langdon of Unionville, Conn., and set up in a little room partitioned off from the main shop. The windows were painted and nailed shut, only those directly interested being allowed in. H. M. Green and W. Harry Steadman were the operators. This machine was a success in every sense of the word, and led the way that completely revolutionized the mode of carriage bolt manufacture then in vogue, from 3,000 to 4,000 bolts being headed by it per day. Harry Steadman says that the second machine was really the first, because he claims that Green and he made it a success. Harry and Green were evidently "chips of the same block" and made a good team, and they cut quite a figure in the business in later years. Green became connected with a bolt works in Amsterdam, N. Y., from which he finally drifted into the livery business. Steadman was a prominent promoter of the short-lived Garrettsville Bolt Works of Garrettsville, O., and afterwards emigrated to Choctaw City, Oklahoma, where he became a leading politician and was elected county treasurer of the county.

After the proved success of the machine at Unionville, there seems to have been considerable strife between the bolt

and nut manufacturers to get possession of these machines. Four of them being built in the years 1857-58 and sold to as many different parties, each buyer being jealous of his purchase. L. B. Frost & Son became possessed of the third machine and, like Langdon, partitioned it off in a room by itself, admitting no one to see it except members of the firm and the operator, Mr. Alvin Pond. Even the heater being compelled to work outside and pass the hot blanks through a small opening in the wall to the header. All carriage bolts were hit three blows to form the head.

During the following years of 1857, 1858 and 1859, Savage, Plants, Clarks and Colemans got possession of a machine by purchase, thereby removing all secrecy. This placed it on the highway of improvement. The first important change was the rock shaft, by Alvin Pond, at the works of the Messrs. Frost, for which Chapin paid him \$50. Then came the hand lever applied by the same party, followed with a longer and wider clapper by Plants square plunger slide and plunger dies by W. J. Clark & Co.'s wrought iron tail piece, by Clarks in 1862, change of clapper from center to wedge side of slide by Lamson, Sessions & Co., at Mt. Carmel in 1868, lengthening the bed, plunger slide and change of tail piece to wedge side by Lamson, Sessions & Co. in Cleveland in 1882. Many other improvements were made by different parties, all of which helped to place the Chapin header where it held first place up to 1890, as the most perfect and fastest carriage bolt forging machine in existence. From the crude ideas of Mr. Adolph Frienck these remarkable machines have grown to the marvelous capacity of 15,000 to 18,000 carriage bolts per day. Hundreds of these machines are still in use. Up to 1890 no bolt factory successfully competed for the common bolt trade without their use.

THE WOOD HEADING MACHINE.

The first bolt heading machine built in Pittsburgh was constructed at the works of James Wood & Co. in 1856. It was designed to rest on heavy timbers and to be held in place by bolts. The frame, or bed plate, was provided with holes in lieu of legs. The holding dies were two inches thick by three inches wide and eight or nine inches long, with a groove formed in either end. They were held down in a square box socket by a strap and two stud bolts, and the pinch to grip the bolts, while being forged, was adjusted by two steel set-screws on the front and back. The stationary socket was cast in the bed and the movable die socket was cast solid in a ponderous lever, pivoted to the left corner of the front end of the bed. This was provided with a roller on the opposite end, which was operated by a grooved cam on the driving shaft, to open and close the dies at each revolution of the shaft. Fastened to this shaft, and in the center of the bed, was another cam, which worked against an inverted (T) lever, pivoted on either end of strong cast iron lugs or projections extending downward from the bottom of the bed. A slide conveying the heading die, or plunger, was attached to the lever with straps and bolts. The cam forced the lever and heading slide forward to compress the bolt heads. A spring board, fastened to the rear end of the machine, returned it to position for reaction. The stock for forming the head was regulated by gauging against the heading die, the adjustment being made by two long taper keys or wedges, by driving one up and the other down through a slot in a square bar, which passed through the rear end of the bed plate, and rested against the inverted (T) lever. The machine ran continuously. A hot rod was placed between the dies and struck and turned four or five times in compressing the head and forming the square. The bolt was cut to the required length by a separate shear lever attachment, also operated by a cam on

the shaft between the hub of the round rimmed balance wheel and bed. The driving pulley was fastened outside of this wheel and provided with a tightener for starting the machine.

THE GREBEN MACHINE.

The Greben heading machine, constructed by John Greben, Pittsburgh, in 1858, embraced the main features of the Wood machine. The bed was mounted on legs. The upper end of the inverted (T) lever was arranged in such a manner as to carry a clapper which came in contact with a cam on the driving shaft, and was raised by a rod that connected it with two buggy springs overhead. The stock for forming the head of the bolt was gauged by a screw and jam-nuts from the rear end of the bed. The motion was continuous and the blanks were cut to lengths and held with tongs while being headed hot.

THE LEWIS MACHINE.

This machine was constructed on different lines, and improved by William J. Lewis, Pittsburgh, in 1865. The method of holding the gripping dies was retained, but the straps were discarded. The movable die socket was formed in a rocker, hinged to the left side of the bed, near the front end, and in such a manner as to align with the stationary die, when raised to grip the bolt while being headed. A lever, hinged to the bed, passed beneath the rocker and up over the driving shaft was operated by a cam, located between the driving wheel and journal. This raised the rocker by the aid of a pin made of soft iron, held in recesses or ball-joints and just heavy enough to resist the pressure required to perform the work. By this means the catching of a bolt between the dies or any undue pressure would bend or upset the soft pin, thus guarding

against accident to the machine. A stock of these pins was kept on hand to replace those buckled or upset while the machine was in motion. The gibbed plunger slide carried a roller in the rear end and was driven forward by a cam on the driving shaft, and thrown back to position by a spring. The stock adjustment was made by a convenient screw on the side. This was also a continuous machine, the blanks being placed and removed while it was in motion, the handling being done with either tongs or off the rod. It also had a convenient cutting off attachment on the right hand side of the bed, and square or hexagon heads were formed by turning the rod back and forth several times. The cutting to lengths was done without changing dies, which was a great advantage in making small quantities. This machine found a ready market. It was extensively sold to railroad shops, bridge builders and the manufacturers of agricultural implements, and is still used to some extent.

THE ORRIN C. BURDICT MACHINE.

Mr. O. C. Burdick of Buffalo brought out a steady motion carriage bolt header in 1870. It was operated with a crank, connection and slide for forming the head. The dies were closed with a cam roller and slide. The slide was connected to a jaw, held on a rock shaft with two dumb bells and ball joints. The stock for forming the head was regulated by a movable gauge, operated by a cam. This machine was designed for making carriage bolts only, and commanded quite an extensive sale on the market. In 1884 Mr. Burdick converted this machine into a rod heading machine by introducing a cut-off back of the heading dies and cutting the bolt from the rod by the movable heading die. This proved to be the most rapid hot rod heading machine ever invented and it still has a large sale among carriage bolt manufacturers.

THE JAMES B. AND LUCAS C. CLARK MACHINE.

In 1880 James B. and Lucas C. Clark introduced a new and ingenious device for forging full square carriage bolts from round iron by a single operation. In front of the round grooved holding dies were arranged thin dies or fingers corresponding in thickness to the length of square to be formed on the bolt, which were thrown forward to support the stock while being driven down to form head and square. This machine was placed on the market and met with fair success. Some of the machines are still in use.

Various other heading machines have been invented and introduced, but only those that have gained some reputation have been especially mentioned under the head of Bolts and Bolt Machines.

SQUARE AND HEXAGON HEAD BOLT FORGING MACHINERY.

The term "bolt forging" is applied to machines that operate hammers for forging the heads of bolts to a desired shape, and thickness, and more especially to those used in forming square or hexagon heads.

THE MINTER FORGING MACHINE.

Mr. James Minter of Worcester, Mass., invented and constructed a bolt forging machine, on which he secured a patent July 12, 1864. It was built upright and on entirely different lines from most of the machines of a later date. The closing and holding dies were operated by a foot treadle, and embraced all the principles of Rugg's heading vise. The driving down of the stock in forming the head was performed by the same movement as the Barnes rounding press. The ham-

mers were also operated with cranks and constructed to work horizontally. The holding dies and vise were in the center of four crank shafts arranged at right angles, which were connected together with bevel gears and also connected by gears to the upright crank shaft for driving down the stock. These several shafts ran continuously and very rapidly. When the bolt blank was fed into the machine these five shafts were made to engage simultaneously to perform the work. This machine is still being used by The American Bolt Company, Birmingham, Ala., formerly of Lowell, Mass., and by a few other factories, but it never came into very general favor.

THE BURDICT FORGING MACHINE.

In 1865 Orrin C. Burdick of New Haven, Conn., invented, patented and built a forging machine that was so simple in construction, so effective in finish and production that it found a ready sale in the markets of the world.

It was operated with a clutch, crank, connection, slide and levers. Four levers were connected with the main slide and hammer slides with adjustable rocker joints. These levers were fulcrumed with suitable pins near the centers, and so arranged as to pass their linked centers during the forward or backward motion of the main slide, thus striking two blows with the hammers at every revolution of the shaft. Two hand levers were used in operating the machine; the first to close the dies with the aid of toggle joints, and the second to throw in and out the clutch in starting and stopping the machine. The bolt head in forging could be struck any number of blows required.

This machine was materially improved by the introduction of an automatic stop, so arranged that it ceased operating after the required number of blows to perfect the work were given, and until it was again put in motion by the clutch. It was

further improved in 1875 by adding a device which closed the dies, carried the bolt blank forward, completed the forging and delivered the finished bolt, automatically. This improvement was also patented, and thus improved, the success of the machine greatly exceeded Mr. Burdick's most sanguine expectations. The rapidity with which it produced its work and the superiority of the finish has never been equaled by any other similar machine. Mr. Burdick styled it "The Advance Header," and it has nobly justified the title.

THE ABBE FORGING MACHINE.

On March 8, 1870, Mr. John R. Abbe of Providence, R. I., secured a patent on a somewhat similar machine, avoiding an infringement on Mr. Burdick's rights. He accomplished the same motion to the hammers, with perpendicular working top and bottom hammer slides, one within the other, operated by levers connected to the main slide, with semi-heart motion grooves. These grooves were reversed in the top and bottom hammer slide working levers, operating them in opposite directions, thus producing the exact double motion of the Burdick machine. The side hammer motion, closing arrangement and starting and stopping devices, were nearly a complete copy of the original Burdick. The Abbe machine was not as durably constructed as the Burdick, but it was widely advertised and commanded a large sale on the market.

THE PAWTUCKET FORGING MACHINE.

What is known as the "Pawtucket" machine, manufactured by The Pawtucket Manufacturing Company, Pawtucket, R. I., is a marked improvement on the original Burdick machine. It is a general favorite on the market and commands a wide sale.

These several forging machines have been largely superseded by the three-blow box-die and one-blow rod heading machines. The former completes the bolt head by compressing the stock with a plunger and the lower groove by one blow, and finishes the head in the upper combination groove, box die and punch, with two blows. The latter compresses the head and cuts off the bolt by one operation. Afterwards the blank is trimmed cold by passing through a die operated by a press.

HOT PRESSED NUT MACHINERY.

THE CARTER AND REES MACHINE.

Henry Carter and James Rees of Pittsburgh, Pa., were the originators of the first hot pressed nut machines of which any record can be found. On August 26, 1851, they secured letters patent (No. 8322) on their first machine, styled "nut and washer machine." "We claim two punches, moving at the same time with different velocities and in the same direction, in combination with the die box within which the nut is formed substantially as herein set forth." After experimenting two years Carter and Rees secured their second patent on November 22, 1853, which proved to be the first machine of the kind ever placed successfully in operation, and it stands to the credit of their inventive genius and mechanical skill that their machine, which was also the first constructed with a box die, has held its place among the best and most profitable of its kind up to the present day. As a matter of course, numerous attempts have been made to improve on the "Old Original," but nothing of sufficient consequence has ever been accomplished to diminish its popularity with manufacturers or to retire it from the broad field of usefulness it has so long adorned.

Cams are ingeniously employed in operating this famous machine. The slide carries a hexagon or square box die and crowner and is moved back and forth by a huge cam on the driving shaft, which works in a yoke of a solid cast slide. The square or hexagon, cutting-off punch, and the piercer or round punch for perforating the nut, are held stationary, facing opposite directions. The forward motion severs the nut into the box die, which forces it against the piercer to punch the hole, and then compresses it against the square or hexagon swaging punch, forming the crown, the punching or pit passing out through a hollow cutting-off punch. The nut is then released and ejected by the crowner, answering a reversed motion of the slide.

While the running of the machine is not very smooth and is far from noiseless, these objections are more than overcome by the simplicity of its construction and its superior productive power.

THE COLE MACHINE.

Mr. Richard H. Cole's hot pressed nut machine employed two parallel shafts, which were connected with gears and operated two punches, which moved towards each other from opposite directions. The stock for the nut was severed and carried into a box die, stationed between the cutting off and crowning punches, and through which the piercers or round punches passed, nearly meeting in the center of the nut being formed, when one withdrew and the other passed through, carrying out the wafer or shuck. During the operation the box die was slightly closed, simultaneously with the punching, with four short levers and a corresponding wedge device which compressed and finished the nut, which was then ejected by the crowning punch. Aside from the compressing movement, the box die was stationary. By this method, so much of the metal was forced into the body of the nut as to materially

reduce the wastage in punchings and scrap. In 1856-57 Mr. Cole secured patents on the tools, devices and machinery pertaining to this process of saving wastage in the manufacture of nuts. The St. Louis Bolt Company of St. Louis, Mo., and The Boonton Iron Works, Boonton, N. J., purchased the right to use the machinery and devices, but both soon discovered that the cost of repairing and renewing tools was so great that they could not be used with profit, nor successfully compete with the practical "Carter" machine. Both discontinued using the machine and practically retired from the nut business. The St. Louis company was subsequently revived, however, and has continued the business from time to time.

Mr. Cole undertook to introduce his machines in England, but meeting with little success, he returned, disappointed and practically bereft of means, having spent the best part of his life and a considerable fortune in perfecting his inventions and in endeavoring to place them on the market. So long as the tools were in perfect order the nuts produced by Mr. Cole's process were unsurpassed for their superiority of quality and finish, and the designs, workmanship and finish of his machinery prove that Mr. Cole was a thorough mechanic. His models in the U. S. patent office are gems of workmanship and are the finest and most expensive to be found in the vast collection in the building.

THE BURDICT MACHINE.

Mr. Burdick operated his hot pressed nut machine from a single shaft, with two slides, one working within the other. The larger or outer slide was operated by eccentrics and the inner, which carried the crowner, was operated by a cam. The cutting off punch was stationary and the piercer, operated by a cam and lever, passed through it. The box die, moving forward, cut off the blank into the box, and simultaneously with the crowning the piercer punched the hole from the oppo-

site direction, the pit passing into the crowner punch, the pit afterwards being pushed out and delivered with the finished nut by the return motion of the machine. Mr. Burdick secured a patent on this machine July 22, 1863.

THE J. NOYES SMITH MACHINE.

Oneida, N. Y.

Mr. Smith brought out his hot pressed nut machine in 1870. It was constructed with a single driving shaft and three slides, telescoped. The outer slide carried the box die; the second, the crowner, and the third, or center slide, the piercer. A crank was used to operate the outer slide and the other two were worked by cams. These were so arranged as to pass the piercer through the nut with a quick motion, while the crowning was being done, the punching passing out through the cut-off punch, and the finished nut was pushed out of the box die by the crowner.

THE STERNBERGH MACHINE.

Mr. Sternbergh patented his hot pressed nut machine May 5, 1896, although he had built and used the machines several years previous. It is a combination of the Cole and Burdick machines somewhat improved. Mr. Sternbergh employs two driving shafts, geared together, which operate two slides from opposite ends of the machine. The box die is stationary and the crowning and cutting off punches work towards the center from either end. The blank is cut off and carried into the box while being crowned. The piercer passes through, forcing the pit into the cutting off punch, from which it is delivered with the finished nut, by a reverse movement

of the machine. The machine is fed from the side like other similar machines and is known as the Sternbergh "Center Feed" machine. This machine is an improvement on one that he invented and patented in 1867.

HOT FORGED NUT MACHINERY.

THE WARD MACHINE.

Mr. William E. Ward of Port Chester, N. Y., was the first to invent, construct and operate hot forged nut machinery on which he secured a patent in 1856. Mr. Ward's machine punched the hole, and, after severing the blank, passed it through a die and held it on a pilot pin, which protected the hole and turned the nut back and forth while the nut was being hammered, with alternating hammers, after which the nut was thrown out by a simple spring attachment. The nuts produced were quite inferior. In design and general construction, the machine much resembled the forged nut machine of the present day, its constituent parts being largely composed of cams, slides and levers. Mr. Ward made many improvements on the machine and it eventually became the principal forged nut machine used by Russell, Burdsall & Ward.

THE PAGE AND HALL MACHINE.

On Sept. 8, 1857, Messrs. Edward Page and Samuel Hall of New York City received letters patent on "an improved machine for forging nuts." This was built on the lines of the Ward machine, but it cut off the blank before punching the hole, by forcing the metal through a die, onto a round punch

where it was held, while being forged, with alternating hammers. The pit passed up into the cutting-off punch and was ejected after the roughly made nut was released and delivered. The nuts produced were not crowned and would compare in quality with the hot pressed nuts of the present day. Claiming that the machine infringed on his patents, Mr. William E. Ward contested the matter in court and secured a verdict in his favor.

THE SAVAGE MACHINE.

On Dec. 8, 1858, Mr. Julius B. Savage, of Southington, Conn., patented "an improvement on forged nut machinery," known as the Frienck machine, constructed on new lines. He employed three shafts. The back or driving shaft was provided with a drum and several cams for operating the punch, the compressing lever, etc., and to the drum were fastened conveying and squeezing devices. The driving shaft was also bevel geared to two side shafts, which operated transfer and squeezing slides. The machine was very complicated and cumbersome. In operation it cut off the blank, transferred it to the crowner, thence to a series of squeezers, from whence it was conveyed to a box, where it was held while the hole was being punched, then the nut was delivered, almost cold, as the slowness of the several operations rendered it impossible to retain the heat until it was completed. The nuts produced were poorly forged and roughly finished. The machine was used to some extent, however, at Mr. Savage's works in after years.

THE KOCH MACHINE.

On May 5, 1863, Philip Koch, of New Haven, Conn., secured a patent on a forged nut machine, which but narrowly escaped encroaching on Mr. Ward's ideas, but passed muster

at the patent office. This machine produced highly finished work and won considerable favor in the market. Mr. Koch's method was to sever the blank, transfer it to the crowning and punching devices and thence onto a pin where it was held and hammered. When the pin was withdrawn, the nut passed under a top hammer, now called the flattener, and thence out of the machine. The machine was complicated, but it did such superior work that Mr. Koch received a large sum for his patent rights.

THE DUNHAM MACHINE.

Mr. Dunham obtained his first patents on forged nut machines June 27 and Nov. 14, 1866, antedated July 1, 1865, which were followed by other patents on important improvements. Mr. Dunham built four machines before perfecting one that proved satisfactory, which was a combination of the above two which he had patented. Its operation was to cut the blank from the bar, force it up into a swage or crowner, and then force it down with a swage punch. It was then transferred, by a side hammer to a position under, and central with the punch, where it was hammered before the hole was made. The hammers held it on four sides, forming a box, while the punch passed through, after which the front hammer carried it under the flattener, where it was slightly compressed, and passed out of the machine. With a few minor changes that have been made, Mr. Dunham's machine is practically the same as it was, when first constructed, over forty years ago. The bottom shear was originally held in a gibbed upright working slide, operated by a lever and cam. During 1880, the slide was superseded by a swinging lever arm and back shaft. Otherwise the original machine remains unchanged in principle and construction. This popular machine has stood the test of time and is still recognized as the leading forged nut machine of the world.

Mr. Dunham introduced several other devices for forging nuts, among which was a machine built in 1864, which used a stationary bottom shear. The top shear and block moved up and down, producing the same result as the present bottom shear movement. In other respects the machine was practically the same as those built at the present day. Mr. Dunham sold this machine to parties in Youngstown, Ohio, where it was successfully operated until the complete destruction by fire of the Arms, Bell Co.'s works in 1889, when it was purchased by the Lake Erie Iron Co. of Cleveland

THE FULLER MACHINE.

In 1865 Mr. George H. Fuller, of Southington, Conn., brought out "The Fuller Forged Nut Machine," which gained some favor in the industrial market, and on which Mr. Fuller secured a patent May 9, 1871, assigned to self and A. J. Fuller, Unionville, Conn., Roswell A. Neale and Amzi P. Plant, Southington, Conn. It had essential defects, however, which hastened its doom, and soon consigned it to oblivion.

THE BLAKESLEE MACHINE.

In 1872, Mr. H. R. Blakeslee, of Cleveland, introduced his forged nut machine, which was tested and found so unprofitable that it was but little used.

THE MARKHAM MACHINE.

In 1886, Mr. Harry Markham, of Cleveland, invented a machine for making two nuts by a single revolution. This twin device was operated by the Oliver Steel & Iron Co. of Pittsburgh, until 1900, when it was discarded. Mr. Markham afterwards took his entire outfit to England where it seems to have departed life.

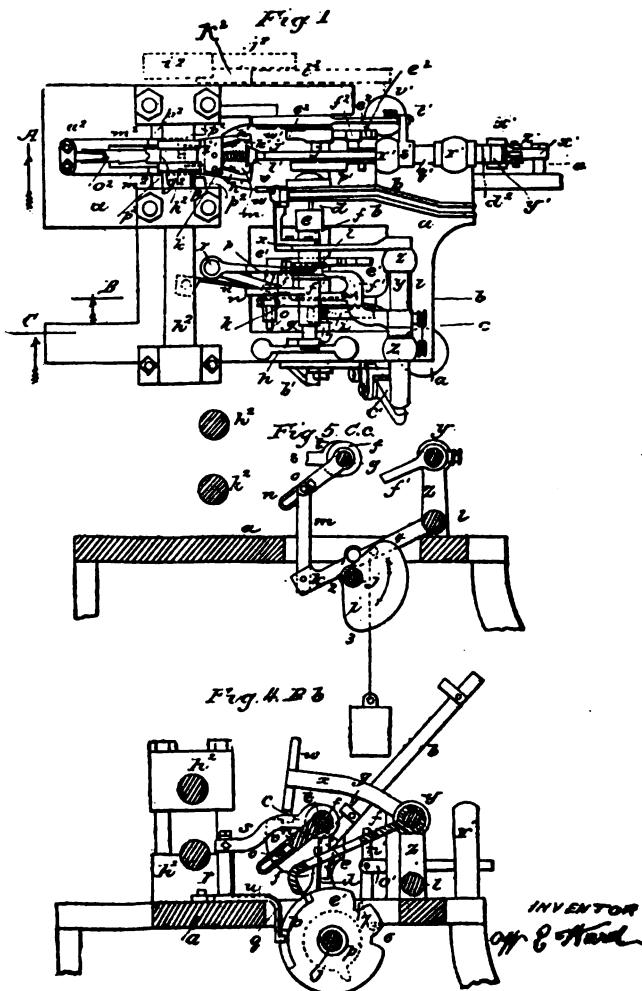
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W. E. WARD.

Machine for Making Bolts.

No. 13,241.

Patented July 10, 1855.



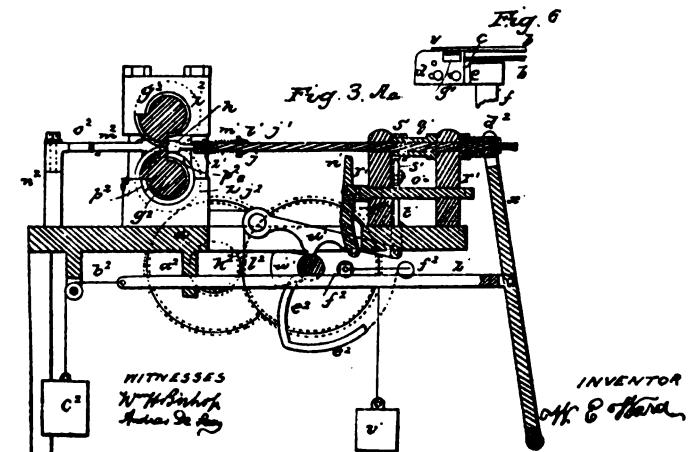
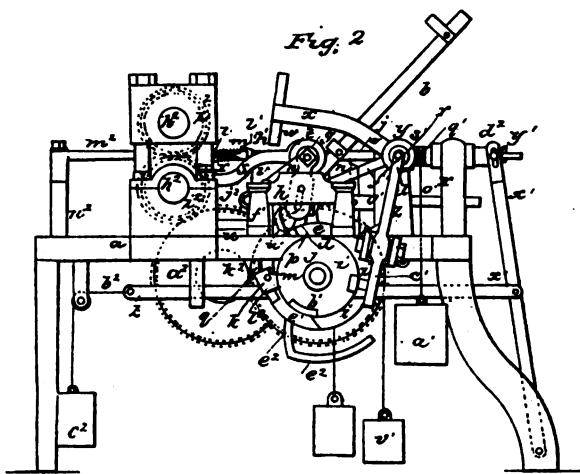
2 Sheets—Sheet 2.

W. E. WARD.

Machine for Making Bolts.

No. 13,241.

Patented July 10, 1855.



THE AUTOMATIC ROLLING MACHINE.

The foregoing cuts and following specifications illustrate the first application of inclined feed ways and transferring spring nippers in the construction of automatic machinery for the manufacture of bolts.

Copy of specification and claims of patent No. 13,241. Wm. E. Ward. Improvements in machines for making bolts. Patented July 10, 1855.—Patent Reports of 1855, Vol. 1.

The bolts pass down between two inclined ways b b; the shanks of the bolts, between the ways and the heads resting on the ways. The foremost bolt, arriving at the semicircular end c of the ways, will hang in a nearly vertical position, with the lower end inclined a little forward, as the weight of the series of bolts on the ways will push the lowest one a little beyond the lowest part of the curved portion c c of the ways. A wing d is thus brought, by an end movement, between this foremost and the rest of the series of bolts. Wing d is fast on a rock-shaft f, which (by means of cams, levers, &c., i k m n) receives first an endwise motion, so as to separate the foremost bolt, as already mentioned, and then makes a quarter revolution, so as to bring the wing, with the bolt on it, to a horizontal position. The bolt is then transferred by spring-nippers w to the jaws h¹h¹, which present it to the rolling operation. In the meantime the wing d returns to its original position, and is drawn back so as to enter afterwards again between the next bolt and the rest of the series, and to repeat the operation already described. The wing and shaft f, while turning back, is drawn back by cam p, arms q¹, and s, on vertical rock-shaft r and collar t. The nippers w are on arm x of rock-shaft y, which latter is drawn endwise by weight a¹, to bring the nippers over the bolt, and it is pushed back to transfer the bolt by cam b¹, on cam-shaft j, acting on

lever c^1 . The nippers are moved twice up and down, to first grip and then deposit the bolt, by the notches 6 and 7, in cam e^1 . The bolt is gripped by jaws h^1h^1 jointed to cross-bar i^1 on the end of mandrel j . The jaws are opened by springs k^1 and closed to grip the shank just within the head by a cone l^1 , which is slid back on the mandrel for that purpose by spring m^1 interposed between the mandrel and cross-bar. A shoulder on the cone is acted upon by a lever n^1 (jointed to adjustable rod o^1) which is operated by a tappet p^2 on wheel p^1 , so that the jaws will spring open as the nippers present the bolt; and as the tappet passes instantly to cone, is immediately pushed back by the spring m^1 to grip the bolt as the nippers rise and leave it. The square mandrel j^1 is fitted to slide and turn with rock-shaft q^1 . The mandrel is turned a quarter revolution by weight v^1 acting on lever u^1 , link t^1 , and arm s^1 on shaft q^1 , and turned back by cam w^1 acting on u^1 , &c.; all this for the purpose of presenting the several angles of the bolt to the rollers, to reduce the end of the bolt to the required cylindrical shape. The mandrel and jaws are drawn towards the segment rollers (that the bolt may be brought to the required position for being rolled) by means of the mechanism y^1 , x^1 , z^1 , c^2 ; the bolt held by the jaws having been introduced between the segment rollers g^2 g^2 , it is free to be moved back by the rollers as they act on it. The mandrel and jaws are drawn back by cam e^2 acting on friction roller f^2 on rod z^1 . The rollers consist each of a segment groove to reduce the end of the stem of the bolt to a cylindrical form. This machine being intended to make bolts, in which that part of the shank next to the head is square and the rest cylindrical.

I claim, in the before described machine, the mode of operation substantially as described, for drawing or rolling, to a cylindrical shape, the end of the stem of square bolts, by means of the segment rollers, in combination with the jaws, or equivalent therefor, on the sliding rotating mandrel, oper-

ated by an arrangement of mechanism such as described, or any equivalent therefor.

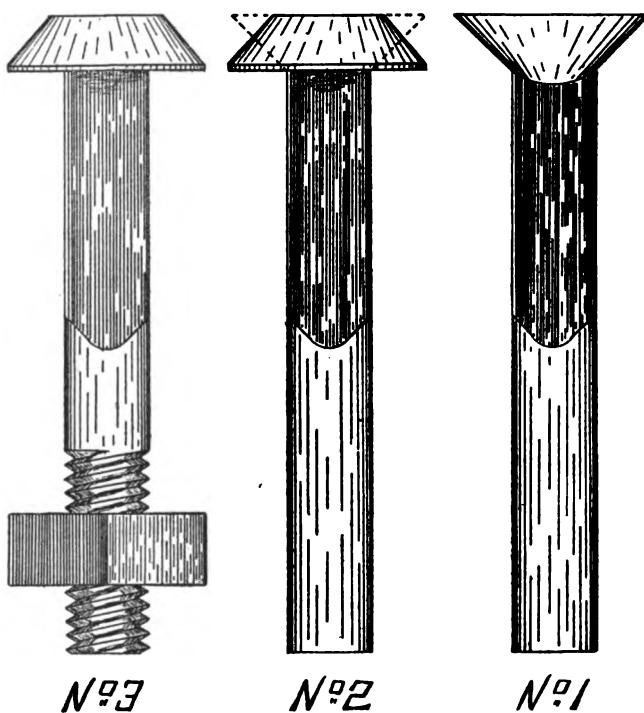
I also claim the mode of operation, substantially as described, for taking the bolts from the feeding-ways, or any equivalent device by which they may be supplied, and bring them to a horizontal, or nearly horizontal, position, by means of a vibrating wing, which enters back of the bolt to be separated, and then vibrates to bring it to a horizontal, or nearly horizontal, position, in combination with the transferring pincers, or any equivalent therefor, by which they are transferred to the jaws; the required motion being imparted by an arrangement of mechanism substantially such as described, or any equivalent therefor.

REFASHIONING BOLTS.

During the earlier years, men of genius engaged in the manufacture of carriage bolts confined their efforts, almost exclusively, to the work of devising machinery and implements that would expedite and cheapen the process of fabrication. An incredible number of inventions resulted, many of which failed to survive the initial stage of plans and drawings, while many others proved worthless after being constructed. This age of invention, however, was productive of numerous valuable ideas, which abundantly proved their worth when more fully developed, and from the general mass were preserved many of the most valuable features found in the perfected bolt and nut machinery of the present day.

During this considerable period of ingenious effort to achieve economy and rapidity in the production of bolts, the possibility of profiting by improving the fashion of the bolt itself seems to have almost escaped notice. The prevailing idea was that a bolt was a bolt, and could be nothing else. Its construction was as simple as that of a sawbuck, and as it performed its functions as perfectly as required, little note

was taken of the possibility of refashioning it to any advantage. Bolts made by machinery were forged from square iron, the head being forged, the square neck being left intact, and the remainder was rounded and threaded to the required length. For a number of years all bolt forging machinery was designed to form bolts from the square rod on this principle.



The foregoing cuts illustrate The Rugg & Barnes method of fashioning bolts from square iron. No. 1 represents the blank with countersunk head formed in a hand tool by driving the stock down with a hand hammer. No. 2 represents the same blank with head turned down to proper shape by the operation of a foot-power drop hammer, as indicated by dotted lines. No. 3 represents the finished product.

It was due to the ingenuity of Mr. William J. Clark of Milldale, Conn., that the method of forging carriage bolts was completely revolutionized in the early 60's.

The records of the Patent Office show that in October, 1859, he constructed dies and produced carriage bolts made from round iron, having the angular neck under the head of the bolt formed by "lateral swaging" or compression of the dies at the same operation by which the head was formed on the bolt by the upsetting die or "plunger."

This was the birth of the "Pinched Neck or Common Bolt" as it was later called, the diameter of the angular neck being less from face to face than the diameter of the round rod, or stem of the bolt, but the diameter across the angles was greater than the diameter of the round stem, and the sectional areas of each part were substantially alike.

This bolt did not comply with the requirements of certain agricultural machine bolt specifications on which he was just engaging and was temporarily laid aside.

In March, 1860, Mr. Clark engaged Mr. E. W. Pierce as machinist, and in the following winter they constructed a heading machine to forge "full square" bolts from round iron, by first upsetting the neck portion of the bolt blank and then "laterally swaging" the angular neck at the same operation of forming the head. This process was complete, but the machine had some defects and was not patented, though it was later made available at forging square heads on bolts and coach screws.

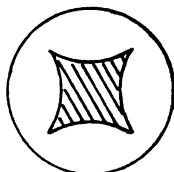


CLARK'S ORIGINAL PINCHED NECK BOLT.

In the fall of 1861 a few of the "pinched neck bolts" were put on the market, and more in 1862, and the great saving on the cost of forging them was in part given to the customers, and the reduction on prices led the trade rapidly from the full square bolts that could not compete in the cost of manufacturing.

On March 17th, 1863, Mr. Clark applied for a patent on the method of making the pinched neck bolt as recited above, and was soon declared in interference at the Patent Office with J. B. Savage of Southington, Conn., who had applied for a patent on the same invention. The contest for priority lasted till August 2, 1864, owing to Mr. Clark's principal witnesses having enlisted in the army and gone to the front in the Civil War, and could not be reached at an earlier date. His priority of invention was established, and his patent, No. 43,669, was granted Aug. 2, 1864. This was the first patent that he applied for, but while it was pending he made other improvements in the forging of carriage bolts, notable among which

was the concaved angular neck bolt, a cross section of which is shown, for which he obtained a patent on Oct. 20, 1863, No. 40,327. Having no opposition to this application, accounts for the later invention appearing first in the recorded issues at the Patent Office. This method permitted the metal forming the angular neck of the bolt blank to be projected to the corners as large as the full square iron would make, and when driven into wood was less liable to split the wood by side-pressure.



CONCAVE BOLT.

This "concaved neck bolt" met with much more favor in the market than the "pinched neck bolt," as it was less liable

to turn in the socket when the nut was screwed on or off, and it commanded a better price. Mr. Clark fortified this invention a year later by taking out a patent on the "Dies" forming the concaved neck. It is No. 44,706, Oct. 18th, 1864.

Again thinking to more clearly define his rights in the manufacture of the common, or pinched neck, bolt, which was being made by several manufacturers without permission, Mr. Clark reissued his original patent, No. 43,669, in two parts on March 28, 1865; the first reissue was No. 1,916, on the "Dies and Method of Making Bolts."

Claim. "The combination and use of metallic dies for the purpose of giving an angular shape or form to a portion of a cylindrical bolt by compression laterally, leaving the remaining portion of the bolt in its original round form, and which dies also serve the purpose of an anvil upon which the head of the bolt is formed by upsetting a projecting portion thereof substantially as described."

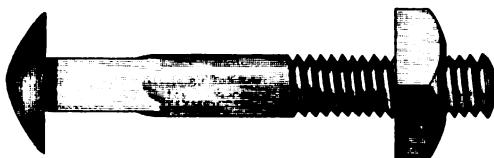
The other reissue was No. 1,917 on the "Bolt" which was made as described above. The infringers were notified of their liability and warned to cease using the patented bolt inventions; but they proved so great a saving that they kept using them in defiance of his claims and warnings.

Soon after this period of time Mr. Clark was visited by an old friend, who was in the government employ in the Territory of Montana during one or two years previous, and who confirmed the published reports of the great wealth of the gold and silver mines therein, and offered such inducements that Mr. Clark was persuaded in May, 1865, to go to Montana with him for a season, and to take a large outfit of machinery for working some of the mines that existed there so plentifully. He left his bolt business in charge of his brothers, who seemed not to have comprehended the full value and scope of his inventions, as they did nothing to protect them, and only worked their factory to its limit on the concaved neck bolt business in connection with their other articles of manufacture.

At the expiration of about two years of unsatisfactory prospecting in the gold regions, Mr. Clark returned home in 1867, and found that a considerable army of manufacturers were using his inventions without a shadow of authority, and he soon adopted measures to defend his valuable rights. Mr. Clark pluckily brought a law suit, for infringement, against Lamson, Sessions & Co., Cleveland, Ohio, one of the largest manufacturers of the pinched neck or "common" carriage bolts. After a year of preparation, and the issues being joined in the court room ready for trial, an agreement was arrived at during the evening previous to the hearing, by which several of the prominent and wealthy bolt manufacturers were to be united with him in fighting for his rights in the courts, in return for the privilege of using his process in their several factories, together with paying to Mr. Clark an agreed upon royalty for the use of his invention.

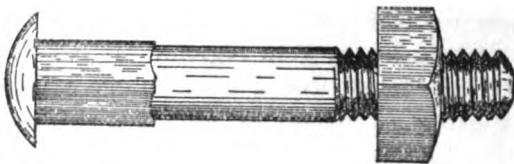
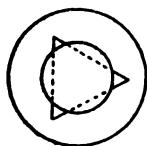
A decree was by joint agreement of counsel entered in his favor by the court, in the cause then pending.

By advice of the joint counsel of the parties it was also advised that Mr. Clark apply for a reissue of his patent No. 1,916 of March 28, 1865, in order to better define his invention. This resulted in the reissue No. 6,291 of February 16, 1875, as an "Improvement on Manufacture of Bolts."



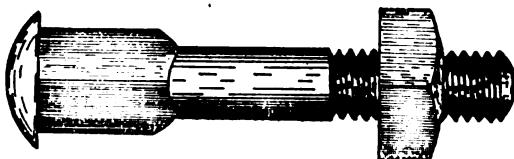
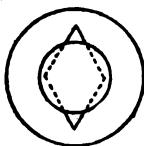
THE POND PINCHED NECK BOLT.

An extensive demand for a cheaper grade of bolts, suitable for constructing the commoner class of vehicles, agricultural implements, etc., was first met by Alvin Pond's "pinched neck" carriage bolt, introduced by Thos. H. Lamson and Walter H. Woodruff, who purchased the patent which merely covered the style, the method of manufacture being covered by Clark.



THE STAR BOLT.

This was soon followed by the star bolt, manufactured by The Plant Manufacturing Co. This was of the pinched neck variety, closely resembling the ordinary pinched neck, and used by the same class of manufacturers and also came under the Clark patent.



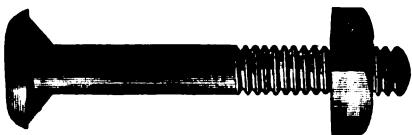
THE DIAMOND NECK BOLT.

Following this came Orrin C. Burdick's diamond neck bolt on which he secured a patent, as the diamond form evaded Clark's patent.



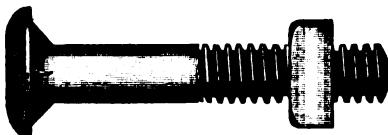
THE BASTARD NECK BOLT.

Then came the bastard square-neck bolt, made with a thin head and short square, and manufactured in large quantities by Hotchkiss & Upson.



THE FIN-HEAD BOLT.

Another notable novelty in the fashioning of bolts occurred in 1890, when Russell, Burdsall & Ward began manufacturing their cold-forged "fin-head" bolt, constructed with two fins, or thin lugs, under the head, to be driven into the woodwork, serving instead of the square to hold the bolt stationary, while the nut was being screwed on or off.



THE WOODFORD FIN-HEAD BOLT.

To compete with the fin-head, The Upson Nut Co. brought out a cold-forged bolt with four fins, or more properly speaking, with a corrugation under the head, operating the same as the fin-head.



THE CORRUGATED-NECK BOLT.

The North cold-forged bolt, invented by W. C. North, of Cleveland, was, in a certain sense, the legitimate offspring of the fin-head and the corrugated head with which it was intended to compete. Mr. North, the inventor, was a veteran in the bolt business, and was traveling as a salesman for The Lamson-Sessions Co. of Cleveland, when the fin bolt was introduced. Mr. North fully appreciated the merit of the fin bolt for cheap trade, as he was somewhat reluctantly forced to do, from the fact that it was cutting into his trade on other styles, and was not manufactured by his firm. How to meet this competition was the question that haunted Mr. North till he found a satisfactory solution by inventing the bolt that bears his name.

Instead of fins or other attachments to the head, the North bolt has a corrugated neck that replaces the square neck on the ordinary carriage bolt. The round of the bolt is, of course, smaller than the corrugated or ribbed neck. The hole to receive the bolt is bored to the size of the round section, and the corrugated neck is driven in. This bolt can be driven through metal surfaces and into solid metal, a thing impossible to either the fin or the common bolt. The demand for this popular bolt at once found in the general market testified to its merit, and it still holds its place unrivaled.

THE BUCKEYE BOLT.

In 1904 The Lamson-Sessions Co., Cleveland, Ohio, introduced their "Buckeye" carriage bolt, with short semi-concave and fillet neck, provided with rolled threads. This style of bolt is commanding large sales and bids fair to hold the market.

W. J. CLARK.
Manufacture of Bolts.

No. 6,291.

Reissued Feb. 16, 1875.

Fig. 1.

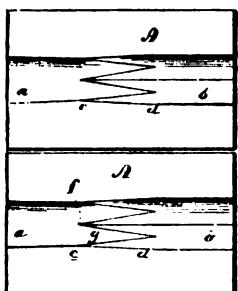


Fig. 2.

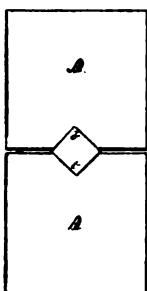


Fig. 3.

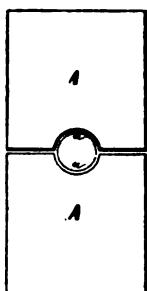


Fig. 4.

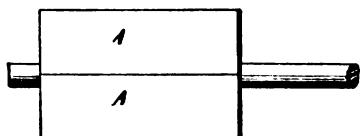


Fig. 5.

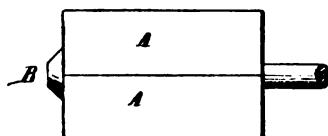


Fig. 6.



WITNESSES

W. D. Newman,
By
O. J. Nottingham

INVENTOR

William J. Clark
Legg and Legg, attorneys.

**WILLIAM J. CLARK'S CARRIAGE BOLT
PATENTS AND COMBINATION
AGREEMENT.**

UNITED STATES PATENT OFFICE

**WILLIAM J. CLARK
of Milldale, Connecticut.**

Improvement in the Manufacture of Bolts.

Specification forming part of Letters Patent No. 43,669, dated August 2, 1864; antedated February 2, 1864; re-issue No. 1,916, dated March 28, 1865; re-issue No. 6,291, dated February 16, 1875; application filed October 31, 1873.

To All Whom it May Concern:

Be it known that I, WILLIAM J. CLARK, of Milldale (formerly of Southington), County of Hartford and State of Connecticut, have invented certain new and useful improvements in the manufacture of bolts from round rods or bars; and that the following is a full, clear, and exact description of the same.

According to my invention, I make an angular-necked round-stemmed headed bolt-blank from a round piece of iron, by first forming the neck into an angular shape in cross-section by lateral pressure at all sides simultaneously, and then, while the said piece is firmly held in proper position, forming its projecting end into a protuberant head of the desired contour by upsetting against the dies, as an anvil, by suitable machinery, that acts to upset the metal against the

anvil ends of the closed dies, and form the head by a motion in the line of the axis of the bolt-blank.

In order that my invention may be fully understood, I have represented in the accompanying drawings, and will proceed to describe, the dies which I have used in manufacturing bolt-blanks according to my invention.

In the drawings, Figure 1 is a view of the dies in plan, opened so as to show the groove in each part thereof. Fig. 2 is a view of the anvil end of the closed dies. Fig. 3. is a similar view of the opposite end of the closed dies. Fig. 4 is a view in side elevation of my invention, showing the bolt-blank inclosed in the dies before the upsetting of the head. Fig. 5 is a view of the same after the head of the bolt-blank has been upset. Fig. 6 is a view of a bolt with one form of head made in my said dies according to my invention.

A A are the dies, provided each with a groove composed of a portion, *a*, which is semicircular in cross-section, and a portion, *b*, angular in cross-section. These two portions *a* and *b*, are merged into each other, substantially as shown, the angular edge *f* vanishing into the curved surface, and the portions *g* of said curved surface vanishing into the flat surface of the angular portion.

In order that the rod from which the blanks are formed may be changed by the dies, so that a portion of it within the dies shall be angular, and a portion circular, or nearly so, in cross-section, the curved surface is preferably made to slightly diminish in diameter as it approaches the angular portion of the groove, as shown between *c* and *d*.

The anvil ends of the dies, as shown in Figs. 1 and 2, are formed so as not to inclose the metal when the protuberant end of the blank is being formed into a head by upsetting the metal thereon as an anvil.

The head, whether of the shape shown, or of any other desirable shape, is formed by any suitable machinery that acts to form the head by driving the metal of the protuberant

end of the rod against the anvil end of the closed dies, the said dies only giving shape to the head upon its under side, and the said upsetting machinery acting substantially in the line of the axis of the bolt-blank.

The operation of the dies is as follows: A round piece or rod of metal, suitably heated, is placed between the open swaging-dies, with a sufficient portion protruding at the anvil ends thereof to form the head. A lateral pressure is then brought against the dies, and they are forced together, giving to the metal substantially the angular shape of the matrix formed by the dies. While the metal remains thus held, the upsetting machinery drives the protuberant end of the rod or piece longitudinally against the anvil ends of the closed dies, thereby forming the bolt-head by upsetting the metal against the anvil ends of the dies, which only shape its under surface.

I claim:

1. The process, substantially as hereinbefore set forth, of forming from a round piece of metal a headed bolt-blank having an angular neck and a round stem, which process consists in subjecting a portion of the length of the round piece of metal to lateral swaging or compression on all sides simultaneously to form the angular neck, and while the piece is firmly held with the neck portion inclosed at all sides, upsetting the projecting end of the swaged piece of metal to form the head of the bolt-blank.

2. The process, substantially as hereinbefore set forth, of forming the angular neck and protuberant head of a bolt, which consists in subjecting a round piece of metal to lateral swaging between angular-grooved dies, the end surfaces of which dies when closed form the anvil against which the projecting end of the swaged piece of metal is upset and formed into a head by proper machinery.

3. The swaging-dies, made substantially as hereinbefore set forth, so that one portion of the cavity inclosed by them

is round, and another portion of said cavity is angular, and the said two portions are connected by an intervening portion of less transverse area than either of the said first two portions, and the ends of the said dies when closed form an anvil at the end having the angular opening, upon which is formed the head of the bolt-blank by proper machinery.

Witness my hand this 10th day of October, 1873.

WILLIAM J. CLARK.

Witnesses:

W. L. BEIMEM,

W. H. ISAACS.

**WILLIAM J. CLARK'S COMBINATION CARRIAGE
BOLT AGREEMENT.**

This agreement made and entered into this twenty-sixth day of March. A. D., one thousand eight hundred and seventy-five, between:

William J. Clark of Milldale, County of Hartford and State of Connecticut, of the first part, and the Peck, Stow & Wilcox Company, Clark Brothers & Company, Levi D. Frost, Union Nut Company, all of the County of Hartford and State aforesaid; Lamson, Sessions & Company, of the city of Cleveland, and State of Ohio; Arms, Bell & Company, of Youngstown, and State last aforesaid; Lewis M. Dayton, of Cincinnati, in the State last aforesaid; and Plumb, Burdick & Barnard, of the city of Buffalo and State of New York:

WITNESSETH: Whereas the said party of the first part is the inventor and owner of certain new and useful improvements in the manufacture of bolts from round rods or bars, and has received Letters Patent therefor issued by the United States of America, and numbered 43,669, and dated August 2, 1864, antedated February 2, 1864, and reissued thereunder number 1,917 for an "improvement in bolts," dated March 28, 1865; also reissue, number 6,291, dated February 16,

1875, for an "improvement in the manufacture of bolts; and

Whereas, the said parties of the second part are desirous of obtaining licenses from said party of the first part for the manufacture, use and sale of said patented articles.

Now, therefore, the said party of the first part for and in consideration of the sum of one dollar to him severally in hand paid by the said parties of the second part, the receipt whereof is hereby acknowledged, and also of other good and valuable considerations, does by these presents license, authorize and empower the said parties of the second part, and each of them, to make, use and sell "Refined Iron" Carriage Bolts under the said Letters Patent, and also the further right to manufacture, use and sell said articles under any reissue or reissues of either or both of said patents that may be hereafter made or obtained, such right to last until the first day of February, 1881; unless sooner revoked as hereinafter provided.

The said rights heretofore granted to the said parties of the second part are to be exclusive rights, excepting and reserving only to the said party of the first part the right to use, manufacture, sell and enjoy for himself or assigns a proportion equal to one-tenth of the whole production, in value, of all the "Refined Iron" Carriage Bolts made under said Letters Patent and under this agreement. This agreement does not include any right to manufacture bolts known as "Norway Iron Bolts."

The said party of the first part for himself, his heirs, executors and administrators hereby further agrees to and with the said parties of the second part, that he will not grant any license or permission to any other person or persons, or firms or corporations, to manufacture, vend or sell the said "Refined Iron" Carriage Bolts, except upon the written consent of a majority of the parties of the second part, who are at the time of the giving of such consent, licensees under this contract.

And said party of the first part further agrees that he will not sell or assign his title to said patents to any persons or corporations or firms whatsoever.

And said party of the first part further agrees that he will, upon receiving a request in writing signed by a majority of the parties of the second part who shall be licensees under this agreement at the time of making such request, and in estimating said majority the said party of the first part shall be counted as one of said licensees, issue and grant to the person, firm or corporation a license to manufacture, sell and vend the above described article, upon the said person, firm or corporation duly executing an agreement to pay to the said party of the first part such royalty as may have been agreed upon by all of said parties signing said request, and such other and further sum as may be agreed upon as compensation for such privilege, which said last mentioned sum shall be divided amongst the parties hereto who shall at the time of such division be licensees hereunder, including said party of the first part. And in consideration of the premises the said parties of the second part for themselves, their heirs, executors, administrators, successors and assigns, do hereby severally and not jointly covenant and agree to and with the said party of the first part, his heirs, executors, administrators and assigns, that they will each pay to the said party of the first part, his heirs, executors, administrators or assigns, a royalty of two per cent. on the amount of sales made by each of said parties of the second part of said bolts made under the patents heretofore mentioned, or under any reissue of the same; the amount of such sales shall be computed as invoiced to the respective customers of the said parties of the second part, whether they be time or cash sales, with the exception of those carriage bolts known as the "Full Square Bolts," which last-mentioned bolts shall be reported and computed at the highest price which is ruling at the time of such sale of "Common Bolts," excepting, however, that the firm

of Lamson, Sessions & Company shall pay a royalty of one per cent. only, to be computed in the same manner as above.

Said royalty shall be paid quarterly on the first days of August, November, February and May, during the continuance of this agreement.

And the said parties of the second part further agree with the said party of the first part, that they will severally make and furnish to the said party of the first part, within fifteen days after the first days of July, October, January and April in each year of the continuance of this agreement, sworn reports of their sales of said patented article aforesaid.

It is further agreed that if either of the said parties of the second part shall fail or refuse to make such reports, or to pay the aforesaid royalty for three months after the said quarterly reports are due, then that said party or parties shall forfeit all rights under this agreement, and said license as to him or them shall cease and be at an end, and that said party or parties shall be liable to an action at law for the recovery of any royalty that may then be due to the said party of the first part.

It is further mutually agreed between the parties hereto that they shall and will adhere and will conform to any and all schedules of prices that may from time to time be adopted by a majority of the parties to this agreement, expressed either in convention or by a written request signed by a majority of the parties of the second part, which shall be duly communicated to all the parties to this agreement. In determining said majority the said party of the first part shall be counted as one. It is further agreed that neither of said parties of the second part shall, directly or indirectly, furnish to any party or parties any bolts made under the aforesaid patents and under this agreement at a less price than that adopted as above provided; and no licensee shall ship or furnish to any consignee any of the aforesaid bolts making the prices thereof subject to any reduction that may

occur after the day of the shipment or furnishing thereof, under the penalty of the forfeiture of their license.

It is further mutually covenanted and agreed between the parties hereto that each of said parties may sell goods made under the license hereby given only in the following proportions:

Lamson, Sessions & Co., 25 per cent. thereof.

The Peck, Stow & Wilcox Co., 16 per cent. thereof.

Plumb, Burdick & Barnard, 16 per cent. thereof.

William J. Clark, 10 per cent. thereof.

Arms, Bell & Co., 8 per cent. thereof.

Clark Brothers & Co., 8 per cent. thereof.

L. M. Dayton, 8 per cent. thereof.

Union Nut Co., 6 per cent. thereof.

Levi D. Frost, 3 per cent. thereof.

And it is further agreed that if it shall appear by said quarterly reports so to be made as aforesaid, that either of said parties shall have sold and delivered more than their share or proportion, as above designated, that then he or they shall and will during the next quarter turn over to any one or more of said parties who shall not have sold their proportion, sufficient acceptable orders to make up his or their proportion if he or they shall desire to receive the same. Said orders shall, so far as possible, be of the same class of bolts as shall be usually made by such party or parties who may be deficient.

It is further mutually understood and agreed that the said party of the first part shall have the right and power to revoke any license hereby granted in the event of any party or parties wilfully refusing to manufacture said patented articles, or who may have refrained from such manufacture, interruption by fire excepted, for the period of six months, or who shall have failed to perform the obligation of such agreement.

It is further agreed that the said party of the first part shall, upon the request in writing of two-thirds of the parties of the second part, revoke the license of such party or parties as may wilfully violate the provisions of this agreement. It is further agreed that for the purpose of a count each firm or corporation shall be entitled to only one vote.

It is further mutually understood and agreed that if either of the said parties hereto shall purchase any Letters Patent for any invention or improvement in the forging or heading of (carriage) bolts, then that he or they shall and will sell the same to the parties to this agreement for the price or sum so paid for the same, together with a sum not exceeding ten per cent. in addition thereto, if a majority of said parties shall vote to purchase the same.

It is further mutually agreed that the licensees under this agreement shall manufacture all bolts under the aforesaid patents in a good and workmanlike manner and to the satisfaction of the party of the first part; and if the said party of the first part shall find that any of the said parties of the second part shall so depreciate the quality and finish of said so to be manufactured bolts as to bring the same in disrepute, and tend to drive or lead the trade to buy or use some other bolt not made under the patent above referred to, then the said party of the first part shall have power to revoke the license of the said party.

It is further mutually agreed between the parties that they will unite in and bring all necessary suits to prevent infringements of said patents, and shall bear the expenses thereof in proportion as they have the right to make and sell goods under said licenses.

And it is further mutually covenanted and agreed that the amount recovered in any such suit shall be expended: First, in repaying the expenses of such suit in which it is recovered; second, in paying to said party of the first part a royalty of two per cent. estimated upon all goods sold by

such infringer and for which damages shall be so recovered; and lastly, to pay the balance thereof, if any, to the parties hereto, in the proportions above provided for.

It is further agreed that if the said party of the first part, or his assigns, shall manufacture said bolts, he or they shall, at the same time provide for the rendering of accounts by the other parties hereto, render like accounts to said parties of the second part; and if he or they shall have manufactured more than his or their per cent., it shall be his or their duty to turn over orders in like manner to such of said parties of the second part as shall not have sold their proportion as aforesaid.

It is further agreed and covenanted that the books of the parties of the first and second part shall be open to inspection of either of said parties, as the case may be, or his or their duly authorized agent or attorney, at all reasonable times during the business hours of the day, and that he or they may have the free access thereto and inspection thereof.

It is further agreed that the said party of the first part shall be entitled to one vote upon all questions that may be put to vote.

It is further agreed that the parties of the second part promise and agree for themselves severally and not jointly with the others, and that neither of such parties is to be liable for any default or improper action of any other of the said parties of the second part.

It is further agreed that this contract shall inure to the benefit of the business successors of the respective parties of the second part upon the same terms and obligations as are herein contained.

It is further agreed that either of the parties hereto may at any time give notice to said party of the first part of their intention or desire to withdraw from and surrender the privileges of such party under this agreement. Such notice shall be in writing and must be at least three months' notice. At

the expiration of the time duly fixed by said notice, and after the payment by said party of any amount justly due under the provisions of this agreement it is agreed that such privileges, licenses, and all obligations of such party thereunder shall cease.

It is further agreed that in case of the forfeiture or surrender of the interest of (either of) the parties of the second part hereunder, such forfeiture or surrender shall inure to the benefit of the other parties ratably, having reference to their respective interests aforesaid.

PRICE LISTS.

The price list, always an essential and indispensable adjunct to the bolt and nut business, passed through a long series of progressive stages before it arrived at the state of perfection in which it is presented to the trade at the present day.

The earlier price lists were printed or written on small cards to be hung up in blacksmith and wagon shops, for the convenience of purchasers. The first of these, of which any record can be found, was issued by A. P. Plant & Co., of Plantsville, Conn., in 1844. It was printed on a card, four by six inches in size. A copy of the list is printed in this work in connection with the history of the Plant Company. The original copy was furnished by Mr. E. H. Plant, who had preserved it among old records in his possession. The prices given on this list were net, but Messrs. Plant soon began giving a small discount to purchasers and, by 1847, the regular discount had advanced to 20 per cent.

In 1851 the representatives of several factories met and formulated the price list as shown and agreed upon a uniform discount of 30 per cent. The meeting was induced by A. P. Plant & Co., and the following companies were represented: A. P. Plant & Co., L. B. Frost & Son, Clark,

Norton & Co., H. A. Miller & Co., Bristol, Moss & Co., Sharon Bassett and Edward N. Shelton. This list was revised and enlarged in 1853, at which time the manufacturers formed an association for their mutual benefit. At a meeting of the association in 1855, the price list was again revised as shown by the following facsimile, and the discount advanced to 40 per cent.

PRICES OF					
FIRST QUALITY WROUGHT IRON					
CARRIAGE, TIRE AND SPRING BOLTS,					
MANUFACTURED FROM BEST REFINED IRON, BY					
L. B. FROST & SONS,					
(SOUTHINGTON, CONN.)					
Post-Office Address, MARION, Ct.					
1-4 Inch Carriage Bolts, with Turned Heads.	5-16 Inch Carriage Bolts, with Turned Heads.	3-8 Inch Carriage Bolts, with Turned Heads.			
1 $\frac{1}{2}$ and 1 $\frac{1}{4}$ Inches, \$2.00 per 100	1 $\frac{1}{4}$ Inches, \$2.25 per 100	2 Inches, \$3.00 per 100			
1 $\frac{1}{2}$ " 2.05 "	1 $\frac{1}{4}$ " 2.30 "	2 $\frac{1}{2}$ " 2.90 "			
2 " 2.10 "	2 " 2.35 "	3 " 2.40 "			
2 $\frac{1}{2}$ " 2.15 "	2 $\frac{1}{2}$ " 2.50 "	3 $\frac{1}{2}$ " 2.60 "			
3 " 2.20 "	3 " 2.65 "	4 " 2.80 "			
3 $\frac{1}{2}$ " 2.25 "	3 $\frac{1}{2}$ " 2.80 "	4 $\frac{1}{2}$ " 4.00 "			
4 " 2.30 "	4 " 2.85 "	5 " 4.20 "			
3 $\frac{1}{2}$ " 2.35 "	4 $\frac{1}{2}$ " 3.10 "	5 $\frac{1}{2}$ " 4.40 "			
2 $\frac{1}{2}$ " 2.40 "	5 " 3.25 "	6 " 4.60 "			
3 $\frac{1}{2}$ " 2.45 "	5 $\frac{1}{2}$ " 3.40 "	6 $\frac{1}{2}$ " 4.80 "			
4 " 2.50 "	6 " 3.55 "	7 " 5.00 "			
7-16 Inch Carriage Bolts, with Turned Heads.	1-2 Inch Carriage Bolts, with Turned Heads.	3-8 Inch Spring Bolts, with Turned Heads.			
3 Inches, \$5.00 per 100	3 Inches, \$7.00 per 100	1 $\frac{1}{2}$ Inches, \$2.90 per 100			
3 $\frac{1}{2}$ " 5.25 "	3 $\frac{1}{2}$ " 7.30 "	2 " 2.95 "			
4 " 5.50 "	4 " 7.60 "	2 $\frac{1}{2}$ " 3.00 "			
4 $\frac{1}{2}$ " 5.75 "	4 $\frac{1}{2}$ " 7.90 "	3 " 3.10 "			
5 " 6.00 "	5 " 8.20 "	3 $\frac{1}{2}$ " 3.20 "			
5 $\frac{1}{2}$ " 6.25 "	5 $\frac{1}{2}$ " 8.50 "	2 $\frac{3}{4}$ " 3.30 "			
6 " 6.50 "	6 " 8.80 "	3 " 3.40 "			
6 $\frac{1}{2}$ " 6.75 "	6 $\frac{1}{2}$ " 9.10 "	3 $\frac{1}{2}$ " 3.50 "			
7 " 7.00 "	7 " 9.40 "	3 $\frac{1}{2}$ " 3.60 "			
7 $\frac{1}{2}$ " 7.25 "	7 $\frac{1}{2}$ " 9.70 "				
8 " 7.50 "	8 " 10.00 "				
1-4 Inch Tire Bolts.	5-16 Inch Tire Bolts.	3-8 Inch Tire Bolts.	1000 5-16 Inch Bolts.		
1 $\frac{1}{2}$ & 1 $\frac{1}{4}$ Inches, \$ 95 per 100	2 Inches, \$ 1.76 per 100	2 Inches, \$ 2.40 per 100	Regular Assortment,		
2 " 1.00 "	2 $\frac{1}{2}$ " 1.52 "	2 $\frac{1}{2}$ " 2.50 "	400-2 Inches, at \$2.35-\$9.40		
2 $\frac{1}{2}$ " 1.05 "	2 $\frac{1}{2}$ " 1.58 "	3 " 2.60 "	300-2 " 2.50-7.20		
3 " 1.10 "	2 $\frac{1}{2}$ " 1.94 "	2 $\frac{1}{2}$ " 2.70 "	200-3 " 2.65-5.30		
3 $\frac{1}{2}$ " 1.15 "	3 " 2.00 "	3 " 2.80 "	100-3 $\frac{1}{2}$ " 2.80-2.80		
4 " 1.20 "	3 $\frac{1}{2}$ " 2.06 "	3 $\frac{1}{2}$ " 2.90 "			
5 " 1.25 "	3 $\frac{1}{2}$ " 2.12 "	3 $\frac{1}{2}$ " 3.00 "			
The above is a Revised Price List, established and agreed to by the different makers, September, 1851.					
Orders solicited and executed with promptness, on the most reasonable terms.					
L. B. FROST & SONS, Near Hitchcock's Station. MARION, CONN. October, 1851.					

PRICE LIST OF CARRIAGE, TIRE & SPRING BOLTS,

MANUFACTURED FROM BEST REFINED IRON, BY

L. B. FROST & SONS,

(SOUTHINGTON, CONN.)

Post Office Address, MARION, CT.

1-4 Inch Carriage Bolts, TURNED HEADS.	5-16 Inch Carriage Bolts, TURNED HEADS.	3-8 Inch Carriage Bolts, TURNED HEADS.	7-16 Inch Carriage Bolts, TURNED HEADS.	1-3 Inch Carriage Bolts, TURNED HEADS.	1-4 In. Tire Bolts, per 100	3-8 Inch Tire Bolts, per 100
14 in. \$2.00 pr. 100	11 in. \$2.35 pr. 100	2 in. \$3.30 pr. 100	24 in. \$5.25 pr. 100	24 in. \$7.75 pr. 100	11 in. \$1.05	2 in. \$2.50
12 " 2.00 " 2.35 " 3 " 3.40 " 3 " 5.50 " 3 " 8.00 "	12 " 2.05 " 2.40 " 2 " 3.50 " 3 " 5.75 " 3 " 8.35 "	12 " 2.05 " 2.40 " 2 " 3.50 " 3 " 5.75 " 3 " 8.35 "	12 " 2.10 " 2.45 " 2 " 3.60 " 4 " 6.00 " 4 " 8.70 "	12 " 2.10 " 2.45 " 2 " 3.60 " 4 " 6.00 " 4 " 8.70 "	12 " 1.05 " 2 " 2.55 " 2 " 4.00 " 2 " 6.50 "	12 " 2.10 " 2 " 2.60 " 2 " 4.00 " 2 " 6.50 "
14 " 2.05 " 2.40 " 2 " 3.45 " 3 " 5.75 " 3 " 8.35 "	14 " 2.10 " 2.45 " 2 " 3.50 " 3 " 5.75 " 3 " 8.35 "	14 " 2.10 " 2.45 " 2 " 3.50 " 3 " 5.75 " 3 " 8.35 "	14 " 2.15 " 2.53 " 3 " 3.70 " 4 " 6.25 " 4 " 9.05 "	14 " 2.15 " 2.53 " 3 " 3.70 " 4 " 6.25 " 4 " 9.05 "	14 " 1.10 " 2 " 2.60 " 2 " 4.00 " 2 " 6.50 "	14 " 2.15 " 2.53 " 3 " 3.70 " 4 " 6.25 " 4 " 9.05 "
12 " 2.15 " 2.53 " 3 " 3.70 " 4 " 6.25 " 4 " 9.05 "	12 " 2.20 " 2.60 " 3 " 3.80 " 5 " 6.50 " 5 " 9.40 "	12 " 2.20 " 2.60 " 3 " 3.80 " 5 " 6.50 " 5 " 9.40 "	12 " 2.25 " 2.68 " 3 " 3.90 " 5 " 6.75 " 5 " 9.75 "	12 " 2.25 " 2.68 " 3 " 3.90 " 5 " 6.75 " 5 " 9.75 "	12 " 1.15 " 2 " 2.70 " 2 " 4.00 " 2 " 6.75 "	12 " 2.25 " 2.68 " 3 " 3.90 " 5 " 6.75 " 5 " 9.75 "
12 " 2.25 " 2.68 " 3 " 3.90 " 5 " 6.75 " 5 " 9.75 "	12 " 2.30 " 2.75 " 3 " 4.00 " 6 " 7.00 " 6 " 10.10 "	12 " 2.30 " 2.75 " 3 " 4.00 " 6 " 7.00 " 6 " 10.10 "	12 " 2.35 " 2.83 " 4 " 4.10 " 6 " 7.25 " 6 " 10.45 "	12 " 2.35 " 2.83 " 4 " 4.10 " 6 " 7.25 " 6 " 10.45 "	12 " 1.20 " 2 " 2.80 " 2 " 4.00 " 2 " 6.75 "	12 " 2.35 " 2.83 " 4 " 4.10 " 6 " 7.25 " 6 " 10.45 "
12 " 2.35 " 2.83 " 4 " 4.10 " 6 " 7.25 " 6 " 10.45 "	12 " 2.40 " 2.90 " 4 " 4.30 " 7 " 7.50 " 7 " 10.80 "	12 " 2.40 " 2.90 " 4 " 4.30 " 7 " 7.50 " 7 " 10.80 "	12 " 2.45 " 2.95 " 5 " 4.50 " 7 " 7.75 " 7 " 11.15 "	12 " 2.45 " 2.95 " 5 " 4.50 " 7 " 7.75 " 7 " 11.15 "	12 " 1.25 " 2 " 2.90 " 2 " 4.00 " 2 " 6.75 "	12 " 2.45 " 2.95 " 5 " 4.50 " 7 " 7.75 " 7 " 11.15 "
12 " 2.45 " 2.95 " 5 " 4.50 " 7 " 7.75 " 7 " 11.15 "	12 " 2.50 " 3.05 " 5 " 4.70 " 8 " 8.00 " 8 " 11.50 "	12 " 2.50 " 3.05 " 5 " 4.70 " 8 " 8.00 " 8 " 11.50 "	12 " 2.55 " 3.20 " 6 " 4.90 " 8 " 8.25 " 8 " 11.85 "	12 " 2.55 " 3.20 " 6 " 4.90 " 8 " 8.25 " 8 " 11.85 "	12 " 1.30 " 2 " 3.00 " 2 " 4.00 " 2 " 6.75 "	12 " 2.55 " 3.20 " 6 " 4.90 " 8 " 8.25 " 8 " 11.85 "
12 " 2.55 " 3.20 " 6 " 4.90 " 8 " 8.25 " 8 " 11.85 "	12 " 2.60 " 3.25 " 6 " 5.10 " 9 " 8.50 " 9 " 12.20 "	12 " 2.60 " 3.25 " 6 " 5.10 " 9 " 8.50 " 9 " 12.20 "	12 " 2.65 " 3.50 " 7 " 5.30 " 9 " 8.75 " 9 " 12.55 "	12 " 2.65 " 3.50 " 7 " 5.30 " 9 " 8.75 " 9 " 12.55 "	12 " 1.35 " 2 " 3.20 " 2 " 4.00 " 2 " 6.75 "	12 " 2.65 " 3.50 " 7 " 5.30 " 9 " 8.75 " 9 " 12.55 "
12 " 2.65 " 3.50 " 7 " 5.30 " 9 " 8.75 " 9 " 12.55 "	12 " 2.70 " 3.65 " 8 " 5.50 " 10 " 9.00 " 10 " 12.90 "	12 " 2.70 " 3.65 " 8 " 5.50 " 10 " 9.00 " 10 " 12.90 "	12 " 2.75 " 3.80 " 8 " 5.70 " 10 " 9.25 " 10 " 13.25 "	12 " 2.75 " 3.80 " 8 " 5.70 " 10 " 9.25 " 10 " 13.25 "	12 " 1.40 " 2 " 3.20 " 2 " 4.00 " 2 " 6.75 "	12 " 2.75 " 3.80 " 8 " 5.70 " 10 " 9.25 " 10 " 13.25 "
12 " 2.75 " 3.80 " 8 " 5.70 " 10 " 9.25 " 10 " 13.25 "	12 " 2.80 " 3.95 " 8 " 5.90 " 11 " 9.50 " 11 " 18.80 "	12 " 2.80 " 3.95 " 8 " 5.90 " 11 " 9.50 " 11 " 18.80 "	12 " 2.85 " 4.10 " 9 " 6.10 " 11 " 10.00 " 11 " 18.80 "	12 " 2.85 " 4.10 " 9 " 6.10 " 11 " 10.00 " 11 " 18.80 "	12 " 1.45 " 2 " 3.20 " 2 " 4.00 " 2 " 6.75 "	12 " 2.85 " 4.10 " 9 " 6.10 " 11 " 10.00 " 11 " 18.80 "
12 " 2.85 " 4.10 " 9 " 6.10 " 11 " 10.00 " 11 " 18.80 "	12 " 2.90 " 4.25 " 9 " 6.30 " 12 " 14.30 " 12 " 24.00 "	12 " 2.90 " 4.25 " 9 " 6.30 " 12 " 14.30 " 12 " 24.00 "	12 " 2.90 " 4.25 " 9 " 6.30 " 12 " 14.30 " 12 " 24.00 "	12 " 2.90 " 4.25 " 9 " 6.30 " 12 " 14.30 " 12 " 24.00 "	12 " 1.50 " 2 " 3.20 " 2 " 4.00 " 2 " 6.75 "	12 " 2.90 " 4.25 " 9 " 6.30 " 12 " 14.30 " 12 " 24.00 "
12 " 2.90 " 4.25 " 9 " 6.30 " 12 " 14.30 " 12 " 24.00 "					12 " 1.55 " 2 " 3.25 " 2 " 4.05 " 2 " 6.80 "	12 " 2.90 " 4.25 " 9 " 6.30 " 12 " 14.30 " 12 " 24.00 "

5-16 In. Spring Bolt, per 100	8-16 In. Spring Bolt, per 100	9-16 In. Spring Bolt, per 100	10-16 In. Spring Bolt, per 100	WROUGHT CUT NUTS, 1-2 in. to 2-1/2 in. Diameter, per 100 lbs.	WROUGHT AXLE CLIPS, (With Nuts—Warranted.)
1 in. \$2.25 pr. 100	1 in. \$3.20 pr. 100	1 in. \$2.50 pr. 100	1 in. \$3.50 pr. 100	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.25 " 3.25 " 1 " 3.25 " 2 " 3.60 " 2 " 4.00 "	12 " 2.25 " 3.25 " 2 " 3.60 " 2 " 4.00 "	12 " 2.25 " 3.25 " 2 " 3.60 " 2 " 4.00 "	12 " 2.25 " 3.25 " 2 " 3.60 " 2 " 4.00 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.25 " 3.25 " 2 " 3.60 " 2 " 4.00 "	12 " 2.30 " 3.30 " 2 " 3.70 " 2 " 4.10 "	12 " 2.30 " 3.30 " 2 " 3.70 " 2 " 4.10 "	12 " 2.30 " 3.30 " 2 " 3.70 " 2 " 4.10 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.30 " 3.30 " 2 " 3.70 " 2 " 4.10 "	12 " 2.35 " 3.35 " 2 " 3.80 " 2 " 4.20 "	12 " 2.35 " 3.35 " 2 " 3.80 " 2 " 4.20 "	12 " 2.35 " 3.35 " 2 " 3.80 " 2 " 4.20 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.35 " 3.35 " 2 " 3.80 " 2 " 4.20 "	12 " 2.40 " 3.40 " 2 " 3.90 " 2 " 4.30 "	12 " 2.40 " 3.40 " 2 " 3.90 " 2 " 4.30 "	12 " 2.40 " 3.40 " 2 " 3.90 " 2 " 4.30 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.40 " 3.40 " 2 " 3.90 " 2 " 4.30 "	12 " 2.45 " 3.45 " 2 " 4.00 " 2 " 4.40 "	12 " 2.45 " 3.45 " 2 " 4.00 " 2 " 4.40 "	12 " 2.45 " 3.45 " 2 " 4.00 " 2 " 4.40 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.45 " 3.45 " 2 " 4.00 " 2 " 4.40 "	12 " 2.50 " 3.50 " 2 " 4.10 " 2 " 4.50 "	12 " 2.50 " 3.50 " 2 " 4.10 " 2 " 4.50 "	12 " 2.50 " 3.50 " 2 " 4.10 " 2 " 4.50 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.50 " 3.50 " 2 " 4.10 " 2 " 4.50 "	12 " 2.55 " 3.55 " 2 " 4.15 " 2 " 4.55 "	12 " 2.55 " 3.55 " 2 " 4.15 " 2 " 4.55 "	12 " 2.55 " 3.55 " 2 " 4.15 " 2 " 4.55 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.55 " 3.55 " 2 " 4.15 " 2 " 4.55 "	12 " 2.60 " 3.60 " 2 " 4.20 " 2 " 4.60 "	12 " 2.60 " 3.60 " 2 " 4.20 " 2 " 4.60 "	12 " 2.60 " 3.60 " 2 " 4.20 " 2 " 4.60 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.60 " 3.60 " 2 " 4.20 " 2 " 4.60 "	12 " 2.65 " 3.65 " 2 " 4.25 " 2 " 4.65 "	12 " 2.65 " 3.65 " 2 " 4.25 " 2 " 4.65 "	12 " 2.65 " 3.65 " 2 " 4.25 " 2 " 4.65 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.65 " 3.65 " 2 " 4.25 " 2 " 4.65 "	12 " 2.70 " 3.70 " 2 " 4.25 " 2 " 4.70 "	12 " 2.70 " 3.70 " 2 " 4.25 " 2 " 4.70 "	12 " 2.70 " 3.70 " 2 " 4.25 " 2 " 4.70 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.70 " 3.70 " 2 " 4.25 " 2 " 4.70 "	12 " 2.75 " 3.75 " 2 " 4.30 " 2 " 4.75 "	12 " 2.75 " 3.75 " 2 " 4.30 " 2 " 4.75 "	12 " 2.75 " 3.75 " 2 " 4.30 " 2 " 4.75 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.75 " 3.75 " 2 " 4.30 " 2 " 4.75 "	12 " 2.80 " 3.80 " 2 " 4.35 " 2 " 4.80 "	12 " 2.80 " 3.80 " 2 " 4.35 " 2 " 4.80 "	12 " 2.80 " 3.80 " 2 " 4.35 " 2 " 4.80 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.80 " 3.80 " 2 " 4.35 " 2 " 4.80 "	12 " 2.85 " 3.85 " 2 " 4.40 " 2 " 4.85 "	12 " 2.85 " 3.85 " 2 " 4.40 " 2 " 4.85 "	12 " 2.85 " 3.85 " 2 " 4.40 " 2 " 4.85 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.85 " 3.85 " 2 " 4.40 " 2 " 4.85 "	12 " 2.90 " 3.90 " 2 " 4.45 " 2 " 4.90 "	12 " 2.90 " 3.90 " 2 " 4.45 " 2 " 4.90 "	12 " 2.90 " 3.90 " 2 " 4.45 " 2 " 4.90 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.90 " 3.90 " 2 " 4.45 " 2 " 4.90 "	12 " 2.95 " 3.95 " 2 " 4.50 " 2 " 4.95 "	12 " 2.95 " 3.95 " 2 " 4.50 " 2 " 4.95 "	12 " 2.95 " 3.95 " 2 " 4.50 " 2 " 4.95 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 2.95 " 3.95 " 2 " 4.50 " 2 " 4.95 "	12 " 3.00 " 4.00 " 2 " 4.60 " 2 " 5.00 "	12 " 3.00 " 4.00 " 2 " 4.60 " 2 " 5.00 "	12 " 3.00 " 4.00 " 2 " 4.60 " 2 " 5.00 "	1 by 1 by 1/2 inch \$10.00	No. 0 Clip is 1/8 by 5/8 inch, 50
12 " 3.00 " 4.00 " 2 " 4.60 " 2 " 5.00 "					Discount per cent.

5-16 Inch Coach Screw, per 100	8-16 Inch Coach Screw, per 100	10-16 Inch Coach Screw, per 100	1-2 Inch Coach Screw, per 100	PLOW BOLTS, With Round or Square Countersunk Heads, and with Right or Left Hand Thread, as may be ordered.
1 in. \$1.70	1 1/2 in. \$1.90	2 1/2 in. \$2.70	2 in. \$3.50	1 1/2 in. \$2.85
12 " 1.75	1 1/2 " 1.86	3 " 2.90	3 " 3.65	1 1/2 " 3.00
12 " 1.80	2 " 1.92	3 1/2 " 3.10	3 1/2 " 3.90	1 1/2 " 3.20
12 " 1.88	2 1/2 " 2.00	4 " 3.20	4 " 4.40	1 1/2 " 3.35
12 " 1.93	2 1/2 " 2.06	4 1/2 " 3.50	4 1/2 " 4.70	2 " 3.50
12 " 2.03	2 " 2.24	4 1/2 " 3.62	4 1/2 " 4.70	2 1/2 " 3.75
12 " 2.10	2 1/2 " 2.40	5 " 3.75	5 " 5.00	2 1/2 " 4.00
			Discount per cent.	Discount per cent.

Machine Bolts, (With Square Heads) furnished to order, of every size and length, at the same rate of Price of Carriage Bolts.

Bolts for M. E. Cars, of every description.

Countersunk Heads.—Carriage Bolts with Countersunk Heads furnished to order, at prices same as for the regular kinds of Carriage Bolts.

Extra or Intermediate lengths of Bolts furnished at proportional price.

The foregoing is a revised Price List of Carriage, Tire and Spring Bolts, established and agreed to by the different makers, January, 1853.

Orders solicited and executed with promptness, on the most reasonable terms.

L. B. FROST & SONS,

MARION, CONN. January, 1855.

Manufacturers on the Canal R. R. one mile West of Hitchcock's Station.

Since then the association has met at varied intervals to adjust prices and discounts to meet the requirements of the trade, and as improved machinery and methods cheapened production, the prices have been correspondingly reduced and the discounts advanced. In 1900 the Association of Bolt and Nut Manufacturers of the United States adopted a standard telegraphic code, copyrighted by E. T. Gilbert of The Michigan Bolt & Nut Company, Detroit. All official price lists are governed by this association, and are termed "Manufacturers' Standard Lists."

As an illustration of the immense decline of prices that has occurred, it may be cited that in 1844, 3"5-16 carriage bolts were sold at \$33.00 per 1,000. In 1902, the market price on bolts of the same size and of a far superior quality, both in material and workmanship, was \$3.60 per 1,000, and all other sizes and styles were sold at a proportionate reduction in prices.

During all these years of declining prices of bolts, nuts and kindred commodities, the style and character of the price list have been working in the opposite direction and advancing with equal if not greater rapidity. The manufacturers realized the convenience and the value as an advertising medium of carefully prepared and attractive price lists and catalogues, and it is due to the diversified taste and ingenuity employed in perfecting such publications that the modest little four by six card of the Plant Company has been superseded by the elaborate artistic and costly catalogues so generally issued by modern manufacturers. Many of these magnificent publications are not only tomes of valuable information but they are works of art, representing the highest achievements of the artist, the engraver and the printer. Many thousands of dollars has been annually expended in the publication of price lists and catalogues, and each year's issue has aimed to exceed those preceding it in attractiveness and utility.

REMINISCENCES.

By William J. Clark.

It is a source of gratification and pride to me that I was born and reared in Southington, Conn., the birthplace and cradle of the bolt and nut business of America, and that it has been my privilege to be closely connected with, and, incidentally, a contributor to, the magnificent development of this widely useful branch of mechanical activity for more than half a century. During this period I witnessed the inception, the toilsome and often disappointing efforts, the many failures and few successes of the earlier ventures in the field, as well as the often slow but always onward progress that finally culminated in what is now deservedly recognized among the mightiest and most completely developed creative industries of modern times.

During the year 1839, Micah Rugg was the first to make and supply carriage bolts, as an article of merchandise. Rugg was a general blacksmith and iron worker. He was a man of industrious habits, progressive ideas, and considerable genius. His small shop was located in the Marion School District, town of Southington, beside a brook flowing from the foot-hills of a mountain near what was known as Kennedy's Comb Factory. Soon after embarking in the bolt business, he formed a co-partnership with Martin Barnes, who, beside working in the shop, took charge of the sales and found a market for their product. It was difficult to induce the wagon makers to invest in "ready-made" bolts. They had been accustomed to making their bolts as needed, and all were suspicious of the "new-fangled" product. Yet, by hook and crook and by trading bolts for other commodities needed, they succeeded in securing a small but increasing demand for their wares. They produced only square iron carriage bolts, heading them by hand, and rounding the stem

with a primitive trip hammer, which made the welkin echo when in operation. It was in this little shop, however, that Mr. Rugg invented and constructed his head trimming machine, patented August 31, 1842, and his treadle heading-vise; and Martin Barnes invented his tail screw reverse solid-die threading lathe, and his rounding press, called the "rattler," all of which were among the earliest inventions of bolt machinery. At this time Rugg & Barnes were monopolists in the carriage bolt business, for they were all there was of it. They had introduced a new industry, however, which soon lured competitors into the field; for in 1842, Levi B. Frost, a neighboring blacksmith, and his son Ira, under the title of L. B. Frost & Son, began making bolts for the market on a somewhat larger scale than Ruggs & Barnes.

During the same year, Stephen Grace, a manly built blacksmith of genteel demeanor, who had been employed in the Rugg factory, where he familiarized himself with the art of bolt-making, induced Capt. Julius Bristol, an opulent farmer, to join him in the business. Under the style of Bristol & Grace, they established a bolt and nut factory in what was known as the "Old Carding Mill Shop," which was located on the Quinnipiac River, on the site now occupied by the Clark Brothers Bolt Co., at Milldale, Conn. (a postoffice division in the township of Southington).

This firm employed several devices for making bolts, fashioned after Rugg & Barnes' inventions, among which was a trip hammer for rounding, an upright vise for holding the bolt while the head was being formed with a hand hammer. The bolts were threaded on a reverse lathe with shifting belts. Nuts were threaded with a common hand brace, hung in bearings at either end. A taper tap was inserted, onto which the nuts were fed by hand and threaded while held in position by a foot treadle and lever. This outfit stood by a window in plain sight from the street, and, when a schoolboy of seventeen, I often stopped to admire the rapidity

and deftness with which Mr. Grace operated that nut threading mechanism. It would have paralyzed a modern twentieth century "walking delegate" to see with what diligence and laborious effort Mr. Grace operated this quaint apparatus, and yet he was both employer and employe. The work seemed very easy for the rugged Mr. Grace, for every movement expressed the "poetry of motion," and his agility was so remarkable as to give me the impression that no further improvement could ever be made in the process of threading nuts! It was a very tedious process to thread a nut in the old way. First, the nut was confined in the jaws of a vise. Then the taper tap, placed in the central socket of the handle bar, was inserted in the hole of the nut, and the first turn of the handle was carefully made to obtain a straight start on the thread, then successive turns to finish the thread, and then the reversing of motions to release the tap from the finished nut, and the job was done, occupying about five minutes and making it possible for an expert to turn out twelve nuts per hour, provided he worked steadily. Mr. Grace's method, however, enabled him to make about three nuts per minute, or 180 per hour, and as eleven hours constituted a day's work at the time, he could turn out 1,980 per day, which being more than enough to supply the demands on the factory, he was not required to work overtime. Indeed, he also found time to superintend or work in the other branches of the business. In 1843, the tenement in which Mr. Grace resided was destroyed by fire, and he then sold his interest in the factory to Mr. Bristol and sought employment elsewhere.

Mr. Bristol removed the machinery and business to another small factory with water power, in the "South End" District, nearer to his home, and continued it successfully, though the stress of competition had induced Rugg & Barnes to retire from the field.

My first connection with the bolt and nut business began in June, 1850, after my return from a year's trip to California, which was terminated on account of severe illness. I accepted a proposition from a local factory to go "out West," selling bolts on commission, under a contract of peculiar carefulness on behalf of the other party, as I was a novice at "drumming" in the bolt business. I was to bear all traveling expenses, and guarantee all credits that I gave. In consideration of these risks I was to receive a special discount on bills, or I could take the customers on my own account. I chose the latter method, and made two trips to Buffalo, which was called "Out West" in New England parlance at the time. These trips made in June and September proved so successful and gave me such an insight into the business that I determined to embark in manufacturing on my own account.

My dealings with Messrs. Clark, Norton & Co., with whom I had been engaged, were so satisfactory that I sought some arrangement with them that might prove mutually beneficial. The result was a joint contract to furnish them with nuts, and incidentally to market their bolts with the considerable trade that I had established and was successfully increasing. I immediately located my nut factory on the site of what was known as the "Old Carding Mill Shop," on the Quinnipiac River, at Milldale, which I was able to purchase at this opportune time, in the fall of 1850. Early in the spring of 1851, I replaced the old building with a new one of two stories, 24 x 50 feet in size. I installed two Welch & Gray power presses, one 3 foot planer, one 8 foot back geared engine lathe, and other necessary equipment, and engaged Micah Rugg, the ingenious and ubiquitous pioneer of the bolt and nut business as mechanical expert and overseer of the factory. I had received no mechanical training, but the lathe and planer were experimenting with me before they had been belted to the power three days. Their operation

seemed to stimulate latent mechanical ideas in me, and my association with the ingenious Micah added fuel to my ambition to achieve improved methods. While the machinery was being placed, Micah and I had discussed many points, and had so freely exchanged ideas on mechanical improvements that my mind was completely absorbed by the subject; but a temporary and quite serious check was given to the development of my genius, and to my highly successful business by a fire that completely destroyed my factory early in the second year. This occurred in May, 1852, but it caused a suspension of only sixty days; at the expiration of which my new factory, with the addition of an L 30 x 20 feet, for a forging room, was completed, equipped and doing business. In later years I have had a suspicion that "the gods on high Olympus" accepted the holocaust that destroyed the old factory, as a burnt offering to the shrine of old Vulcan, and thereby terminated the "hoodoo" that had seemed to pervade the premises for nearly two generations.

I found that the title to the mill site had been held by deeds through ten different owners in thirty-seven years previous to my purchase in 1850, and had also been the subject of many mortgages by some of the owners. A variety of enterprises had been conducted there, and several important inventions appear from our retrospect to have been born upon these premises.

Of Jasper Johnson, the first owner of record, 1812-1814, little can be said at this late date. His birthplace was the adjoining farm, and though of an enterprising temperament, the land records indicate a waste of his inheritance, and he soon disappeared from those parts, leaving an unsavory memory of events now shrouded in the misty past, from which we will not try to resurrect them.

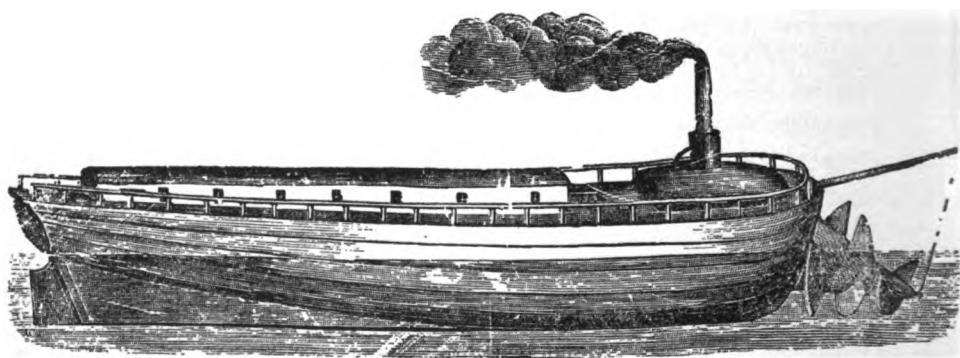
The two or three succeeding proprietors were of respectable qualities and character, but the age of the "pioneers" had not run on sufficiently long to weave successfully the

farmer youth as "warp" into the manufacturer as "filling," in the great manufacturing fabric that now overspreads the country almost from ocean to ocean. From 1814-1818 passed three owners over the premises, with little to record as noticeable results.

Then came one Benjamin D. Beecher (always called by his mid-title "Dutton"). He was of the pioneer stock, a farmer boy, but a *Beecher head* on his shoulders; that stands for individuality, independence of thought, persistency of action. He had such inventive genius that when of age he set at work to improve the crude farm tools. I can only notice such of the shades as still cling around the old mill on the Quinnipiac, now the Clark Bros. Bolt Works. Here he got power and facilities for making his "Fanning Mill" that he had patented in 1816, to clean the grain of the farmers ten times faster and better than the old fashioned "Fan," on which the operator could take but a few quarts of grain at once and toss it up in the breeze repeatedly till the chaff and dirt was blown away, then repeat with another batch. Mr. Beecher had the pioneer mill in this country, and notwithstanding such incredible results of its work savings, he had to rig a large platform wagon and take on six mills at one time, and with a two horse team drive around to the farmers' premises and leave a mill in their barns, to be tried or used until he should call for it later. The use so quickly proved the great saving of time and labor and perfection of work that the mills had to be kept, though the dollars to pay for them came very hard and slowly. The country was poor in cash then, and the shoemaker and the tailor practiced going from house to house among the farmers, upon engagements to shoe and clothe the families from the homespun material that had been wrought and saved up for that purpose.

Mr. Beecher was too fertile in inventions for the period, and in about five years (1823) he sold this factory to embark in a new invention.

This new proposition being large for his capital was probably retarded by many minor efforts intervening, and was not finished to a working test until 1833. It proved to be a screw propeller and engine applied to a steamboat, and was adapted to navigate upon the Farmington Canal that traversed the State near the vicinity of the old mill. It was designed to supersede the towing of boats by horses, and as he had observed in such operation the obstructing water piling up at the prow of the boat he placed the mechanism at the *front* as shown in the plate herewith. Fitch, and Stevens, and Fulton had made efforts at steamboats with side paddles, and side wheels, and Captain Ericsson had taken an English patent for a segmental screw propeller in 1836; but Mr. Beecher had his boat afloat in 1833 and made a successful trial trip from Beachport (now West Cheshire) to Hitchcock's Basin (now Milldale), on the Farmington Canal, four miles and return, with a company of guests of which Admiral Foote, then a lieutenant in the Navy, was one.



THE FIRST PROPELLER INVENTED.

This model was adapted with its single screw to the small canal with its boats of twenty to twenty-five tons burden, and he did not patent the invention until he had received

assistance from a New York capitalist in 1839, when he took out his patent for a twin screw propeller with the mechanism placed at the prow of the boat similar to the one in 1833. This patent is No. 1,459, and dated December 31, 1839, and Mr. Beecher, with the aid referred to, went right on constructing a twin screw propeller for operation on the Erie Canal, and it was reported to have been launched at Troy, N. Y., but the history of this enterprise seems to have faded out, as the death of the financial backer unfortunately occurred and tied it up just at the opening; but the screw propeller for a steamboat appears to have originated with Beecher, and he adapted it to work in the canals with the least damage of washing the banks by the agitation of the water, and getting at practical results in towing other properly constructed barges like to a modern train of cars on a railroad, as shown in the drawings of the patent.

Fig. 1 is the top view of the bow of boat furnished with two screw propellers.

Fig. 2 is a side view of the same.

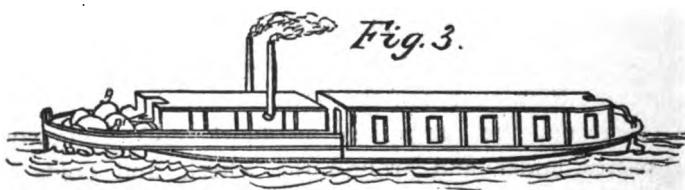
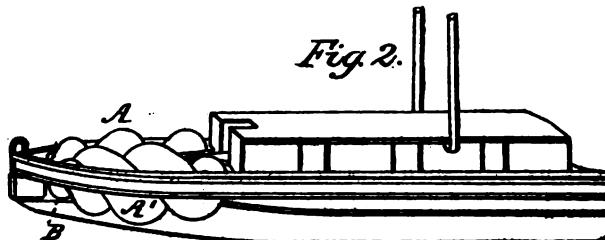
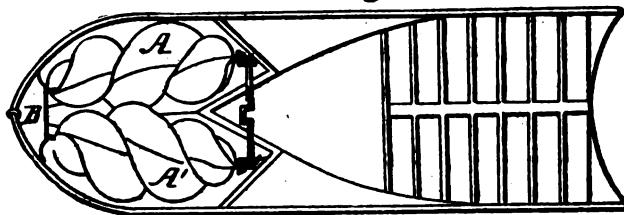
Fig. 3 represents such a boat having a second boat in tow.

A A' are two spiral, or screw wheels, represented as having each four spiral wings or threads, one wheel being a right and the other a left-handed screw propeller, the threads winding at an angle of about 45 degrees. They are made to taper each way, from the center towards the ends, where the wings or threads are rounded, their shafts inclining towards each other as they approach the bow.

B represents the front bearing block and framework, which passes under and around the wheels and holds the bearing block in position.

How narrowly did my little mill site escape being immortalized as the launching place of the first screw steamship propeller! The New Haven & Northampton Canal passing in the vicinity got it away, as the boat with its screw propeller at the prow, as shown above, made its trial trip

B. D. Beecher.
 Screw Propeller.
 No. 1,459 Patented Dec 31, 1839
 Fig. 1.



successfully upon its waters in 1826. The excitement of the rural community over the marvelous performance of the little craft might properly be said to exceed that of the native Americans at seeing the fleet of Christopher Columbus approaching their shores in 1492. No helping capitalist being ready at hand to exploit the new invention that had exhausted the means of its constructor, he was obliged to moor it at the dock in "Beachport" (now West Cheshire) for an indefinite time, while he sought other employment to obtain support for his family.

The next proprietors of the mill site appear in 1823 to 1825 to have been numerous, four of them, a family of Moss by name; and out of the half dozen or more in interest, evolved the carding machine and loom, for first treating the wool clip for the surrounding farmers, ready for the spinning wheel at their homes, and then weaving into cloth for the family use the yarn that the wives and daughters had spun in hours not required in their housekeeping duties. The carding machine and the loom run by the water mill became an important factor in the domestic life of the community in this way up to 1836, and it is dimly remembered by the writer now, how in that period of sixty-eight or seventy years in the shadowy past, the long strips of cloth were stretched for drying on the tenter-hooks on the board fence set for the purpose in the meadow opposite the factory, as he passed and repassed in attending the old "Red School House."

The "Old Carding Machine Shop" became indelibly stamped upon the premises, though no lettering was anywhere visible, until I tore down the old building in the winter of 1850-51.

After the loom and the carding machine passed, came one Lemuel Andrus in 1836, to try to exploit the water power to advantage on other lines, and holding the title till 1850. He was of a mechanical disposition, and had some

practice to his credit. He made carriage shafts and other woodwork for carriages, from the native hickory, for the New Haven carriage makers; he also employed one or two wood turners upon any specialties desired in that line. He also manufactured the metal pointers, or hands, for the Bristol clock makers for a time, until they got into discredit by the destruction of their own profits by reckless competition with each other. Then, becoming weary of unprofitable conditions in his lines of manufacture, in 1842 he leased the premises to Bristol & Grace, previously referred to, for manufacturing carriage bolts. They vacated in 1843.

After the glut in the clock market subsided, owing to failure of the manufacturers, one of the Bristol foremen who had saved up some money, came down to Southington in 1844, and leased the then idle Andrus factory, and filled it with skilled artisans, tools, and machinery for making the clock cases of wood with mahogany fronts, and buying the brass movements in Bristol and fitting them in, and shipping the completed clocks to the New York market. This made a great boom of business for the little village, at eleven hours per day, for about two years, when this collapsed, and the "hoodoo" was upon the place once more.

Again Mr. Andrus occupied the premises, with a worthy effort to establish a new industry, which was no less than forging horse nails by machinery. He secured the services of an ingenious blacksmith named James Thorp, to combine with his own skill; and a massive machine of cast iron, with large wrought shafts and a huge cast fly wheel, was built and brought in, in pieces, being too heavy to move in whole; it was set up with much labor and effort. A new Tyler turbine water wheel was put in also to propel the nail machine; suitable dies were made and set in place, and the rotary machine started; the fires of Vulcan flamed up on the forge; the heated rod of iron fed in was quickly chewed up in the intricate insides of the machine, and headed, tapered, and

pointed, the nails flew out, "thick as leaves in Vallombrosa." The noise was terrific to my youthful ears, but the broad smile of Mr. Andrus' thin face then has a distinct place in my memory, lasting beyond the clatter of the wonderful machine. This, too, was a "nine days' wonder."

Some said the nails would not drive in right, like the "hand made"; others said the dies did not last, so as to make nails profitably. I was too young to understand things much, but Mr. Andrus had my admiration and sympathy, for the nail machine performed only in fitful periods for a little time, and was then left in idleness till a new customer desired to lease the premises, when it was carted away in pieces, I knew not whither.

Again my little mill site missed to connect on what is now a manufacturing line of enormous proportions—machine made horseshoe nails. The first failures were stepping stones to a right knowledge of the laws of mechanics and metallurgy, now better understood in this country.

The next occupant of the premises was Mr. J. B. Savage, who was making cold punched nuts in a small way in the "South End District" of this same town. He desired more power, and hired these premises in 1849 for one year, and I bought the factory and water rights at the end of that lease, as I have previously related.

Nuts, washers, and a few specialties were the product of the factory, and until 1854 I was, to use a colloquial phrase, "chief cook and bottle washer." I was buyer, seller, book-keeper, packer, shipper, correspondent, and general superintendent, and realizing that better results could be obtained by dividing the increasing duties, I negotiated a partnership with my two brothers, Henry H. and Charles H. Clark, and the firm of William J. Clark & Co. was the result.

Perhaps I am writing history rather than reminiscences, but the two are so closely allied that I doubt if I can keep them separate or from co-mingling them occasionally.

In addition to the many-sided positions that I had filled as previously noted, I extended my sales account by buying and selling the articles of hardware of other manufacturers, with a special discount as my reward, but I kept mostly in my own lines, thus building a trade beforehand for my own expansion when able to put in the machinery. I opened trade with Smith & Meadowcroft of Lowell, in 1853, for coach screws, and nuts of sizes larger than I could then manufacture. Mr. Smith was an industrious, "greasy mechanic," of medium size; while Mr. Meadowcroft was a sturdy blacksmith, of heavy frame, with an arm that might knock out a prize fighter if it hit him in earnest (he was an Englishman); one eye was defective, but the other was so good that when he piloted me through the forging shop when I visited there, he looked like a massive Cyclop among the fires that glowed, and the hot irons flashed and sputtered under the hammers. This busy firm grew — all worked — and in 1855 added Mr. Sherman to it as the office partner. Our exchanges with them in 1856 exceeded six thousand dollars.

In July, 1857, this firm of Smith, Meadowcroft & Sherman was organized into the American Bolt Company, and as our firm (Wm. J. Clark & Co.) had from time to time increased its machinery and motive power, and capacity of production, we diminished our purchases from them.

One episode of Mr. Meadowcroft's career will here be an opportune tribute and also exemplify his business probity and sterling manhood.

The writer had by some brain racking study, and sundry experiments, sought to avoid the tearing of the metal in cold punching of the holes in the heavier of the nuts used on railroad or other heavy work. It had been a trick of the "cute" salesman when canvassing for trade in the railroad shops or car works, to select from the threaded nuts of some competitor, a sample that showed some crumbling of the metal in the center of the hole, then with his knife point proceed before

the inspector to pick out a few slivers from the thread! The effect on sales was sometimes wonderful!

A second punching of the hole would obviate this, but added expense to the product, and the writer had so substantially overcome the difficulty at a single stroke that we took much of the very critical trade.

Mr. Meadowcroft had become a large manufacturer and some of his customers had prodded him about this defect in his product as compared with the Clark's.

He came from his Lowell factory down to our office at Milldale as early as 1855 or '56 and laid before us his inability to punch so smooth a hole in the nuts as we did, and he desired to buy, hire, or borrow our secret. He would not seek our workmen to disclose it, but wanted to buy the use of our skill in his shop.

We admired his manhood, but being in the same lines of manufacture, it seemed painfully unwise, and totally unbusiness-like to give him the information, but we would do him the same courtesy that he had to the writer and conduct him through the factory "at owner's risk," which we did much to his gratification and thus closed the incident without harm resulting to either party.

We were also carrying along quite a trade for carriage bolts since 1854, for L. B. Frost & Son, up to 1857. This business was over five thousand dollars per year (quite a respectable business for those early times of manufacturing). This firm seems to have curtailed its business under the stress of the panic of 1857, for a time at least.

We also had the exchange trade (nuts for bolts) of Dwight Langdon, of Unionville, Conn., from the date of his beginning the manufacturing in 1854 until 1856, when he changed his nut purchasing for a year. The panic year of 1857 caught him "short of funds" though, and he suspended payments. While he was adjusting his old affairs, he applied to our firm to furnish nuts and iron for bolt making, so as

to keep the workmen in part employment, and we to own the output. The plan was adopted, we sent nuts and bolt rods, and in a few months Mr. Langdon had settled with his creditors and resumed control of the factory and business. I remember while this was taking place that he came to me one day, to consult about supplying a young man, a brother-in-law of his, with bolts to peddle, by means of a horse and wagon, to the cross-country blacksmiths and wagon makers. I encouraged the project to extend his prospective trade even by this little addition, if he had confidence in getting his pay.

I had no idea at that time that I was hatching the duckling, now developed into The Upson Nut Co. Such marvels does the whirligig of time afford. I am confirmed in belief of the story of the "fat kine" and the "lean kine" that came out of Egypt — one *absorbed* the other!

The simile does not apply to the famine in Egypt part following though; but this young man was Andrew S. Upson, who needs no introduction now to the bolt making fraternity.

Our timely assistance had placed Mr. Langdon on his feet again in the factory, and the diligence of the young bolt peddler in his small beginnings had commended itself to Mr. Langdon as time ran on, for he had not only covered several of the New England States in his dealings; he had doubled his transportation facilities by a span in place of the one horse wagon, and often shipped orders direct from the factory to the customers, or to distant points to replenish his own stock, without coming in from his circuit, and extended his wagon trade even to Long Island.

Mr. Langdon, failing in health slowly but persistently by the dread malady consumption, which had fastened upon him, was induced to utilize the services of the bright young salesman in his factory, where he made himself generally useful; while Mr. George Dunham, an experienced bolt maker from Southington, was engaged early in 1859 as superintendent. That they were both proficient is evidenced by the fact that,

as Mr. Langdon had to face the inevitable with his disease, he negotiated an agreement or an understanding, early in 1860, that Messrs. Upson and Dunham should take over and continue the business at a price agreed upon, after paying the current expenses of the factory.

Mr. Langdon died in the spring of 1860, and the new firm of Upson & Dunham was installed, and carried out the program; and it was reported that the widow of Mr. Langdon received ten thousand dollars for the concern. (I only mention it to show the competency of the young men in charge as the estate was insolvent in 1857.)

Probably Mr. Langdon got an unusual profit on the little business after his resumption, by the introduction of the first Chapin heading machine, and getting the full price for his work; and as he also a little later bought presses to make nuts, our interest in his business diminished or ceased, as our firm had also been adding, from time to time, bolt making machinery, as fast as we could provide increase of motive power to operate it, and the time seemed ripe to enlarge to meet the wants of our trade. The original Martin Barnes was employed in 1857 to superintend a new pair of tire bolt threading spindles — cutting the threads in cylindrical revolving dies, as many as eight to ten thousand bolts per day being easily the output to one operator, if sufficiently expert to handle so many bolts; and tapping spindles were invented and constructed then to thread the nuts for these bolts about as rapidly, and in the next year some three-jaw spring lathes were built to thread larger bolts, and four-jaw lathes also, of larger capacity, to thread coach screws, these being headed by the old hand method, and the carriage bolts also up to 1859, when we bought our first Chapin header early in that year. This machine, with one expert man and an ordinary helper to heat the bolt blanks, headed four to six thousand carriage bolts per day, which was marvelous then as compared with the hand heading of one thousand to two thousand per

man, according to the size of the iron. Now I suppose the experts double the early output.

With the introduction of this Chapin header, we employed Daniel Watrous as a mechanic to make tools and dies for it, and to be generally useful.

We had been making plow bolts of special patterns since 1854 for the steel plow makers of Illinois, and more particularly for Toby & Anderson of Peoria, who I credit with being the pioneers in that important industry. Parenthetically, I may state that Mr. Toby was a wood workman, and Anderson a blacksmith, and they jointly recognized the great need of a better plow than the cast iron one in use, to turn over the tough sod of the vast prairie farms of their State. They formed one by the forge and anvil and hand-hammer means from sheet steel; Mr. Anderson being of the most robust physique, turned the grindstone, while Toby held the plow on, to polish off the "mould-board" and "land side" to a smooth finish, and also made the woodwork. The new experimental plow was launched by a farmer, and at once created a demand for more by the perfection and comparative ease of its work. The first year's output of two or three hundred, made in rather a primitive way, with a horsepower machine for a motor, was doubled the next, and the next year doubled the last one; and thus it went on till steam power and up-to-date machinery formed every part by thousands annually, and a merited fortune was won by these benefactors of the great farmer class of the prairies. Imitators arose in plenty, but "Clark" made the bolts for the pioneers, and kept in touch with the growth of the art in the Western States, and only had to assure a new firm in the business that we made the bolts for Toby & Anderson from the start, to readily get the trade.

We had made our plow bolts mostly by the hand process up to 1859, except such patterns of square countersunk heads as Russell, Burdsall & Ward made, by power heading machines, we bought of them, or had carried on a friendly trade

with them for the four years previous, furnishing them "cold pressed" nuts when they required them, as their machinery was all for forging nuts hot.

I very soon made plans, and set Watrous at work constructing an attachment of mechanism to the Chapin header, so that he could head ten thousand plow bolts per day of the steel plow patterns, which were then new to the trade — special form of heads. It was a great stride for us, as the old way yielded about two thousand per day to the man.

Of course, we kept a spring latch on the door to keep out intruders. The mechanism lasted the one season, but it was not sufficiently heavy to be permanent, and I later made another machine better to do the work.

In 1860 we added another Chapin header for the carriage bolt making, and began some experiments in making carriage bolts from round iron, in order to thereby save the expense of rounding the square iron for the stem of the bolt. I had dies constructed to swage or pinch the angular neck on a round bolt blank at the same stroke of the header that formed the head on the blank. This was practicable, but the square was too small for the trade I was then supplying, and I temporarily laid the dies aside till I had more leisure for experiments. We had the Buckeye reaper trade to supply with bolts at Poughkeepsie, N. Y., and at Canton, Ohio, at that time, and the "full square" were required. Later on, after applying for a patent on the method of making the pinched necked bolt, and being held up by an interference with J. B. Savage, I made some dies with convex faces on the angular part, and thus got the metal swaged out to the corners of the square part as large as a square iron bolt. I patented this October 20, 1863, without any objection, while my first application was awaiting the taking of testimony of some witnesses that were in the army and not accessible, that came in time; and my patent also, as at first sought, was granted August 2, 1864. This patent was reissued in two parts March 28, 1865, and

was reissued again February 16, 1875, to better define my invention.

In 1860 I employed E. W. Pierce, a machinist, and in the following winter he constructed for us an improved double stroke heading machine to perform many of the requirements in our line. It headed plow bolts rapidly, and would head square head bolts and coach screws to our advantage. But soon after completion the Civil War came on, and changed our talent into other lines; the regular business was paralyzed for a time, but the government soon found the waste of war demanded more arms and equipments than the armories could supply, and contracts were placed outside. Thus we met a demand for gun screws, washers, etc., and as that work was very exacting we installed costly machinery to meet the requirements in that line. Mr. Pierce was successful as a tool maker for this business also, and we furnished several hundred thousand sets of gun screws and washers for the gun makers and the armory at Springfield, Mass. This demand closed with the war in 1865.

Now to retrospect a little more regarding the state of the art, the first innovation from the square iron carriage bolt that I discovered in the market was the short upset square neck bolt made by Russell, Burdsall & Ward, in Portchester, N. Y.; that I found in some of the small shops of consumers of bolts, cast iron plow makers, etc.; these bolts would be used reluctantly generally (by reason of the shortness of the square), but they came in with their square countersunk head plow bolts made by the same firm, and which were easily the best made of that kind in the market. The machine for this work was patented by Mr. William E. Ward, July 30, 1850, and was a very long step ahead in bolt making mechanics; but *competitors' salesmen* would howl down the "ridiculous shortness" of the square neck of the carriage bolt, and the trade generally fell in with them, and for a few years Mr. Ward had his life made miserable in this line, for he was made up

to run as precise as any other machine. Mr. Ward insisted that the *only function* of the square neck was to hold the bolt from turning while the nut was being screwed on or off; and his bolt did that. What more could he do? The influence of the great hardware store of Russell & Erwin, in New York, was enlisted in the distribution of the Ward bolts, Mr. Russell being the senior partner in the bolt works at the same time. But notwithstanding all of their efforts at pushing the carriage bolt trade, it did not compete strongly with the old kind; and, as Mr. Burdsall, once in later years, when I was at their office, and Mr. Ward also being present, related as a bit of reminiscence and pleasantry at Mr. Ward's expense, how Mr. Ward's wrath was kindled at the great stupidity and perverseness of the carriage bolt dealers, that they could not or would not recognize "a good thing" when they saw it, that the new bolt weighed less, cost less in iron and in labor of making, and contained all of the strength of the old kind, and his very, very great chagrin at being obliged to yield to the mistaken but popular notion of making the long square neck on his carriage bolts. He insisted that the *only function* of the square part under the head of the bolt was to hold the nut from turning when the nut was being screwed on or off, and that his new bolt, made with the short upset square completely met all of that requirement and it was with a heavy heart, but with his resolute manner, that he turned his mechanical brain upon the task of producing an improved machine for automatically rounding the stem or barrel of the bolts made from square iron so as to leave the square of any length desired, and at less expense than the old method that had been employed.

This effort resulted in the machine patented by Mr. Ward, July 10, 1855, and No. 13,241 (not 1853, as stated in their sketch). This purports to perform the improved method desired, but I express doubts as to its results in practice, for reasons that I will give later, as I must get some of documentary character.

In the patent above recited, and after a lengthy technical description of the drawings, Mr. Ward in closing says: "This machine, being intended to make bolts, in which that part of the shank next to the head is square and the rest cylindrical."

"*I claim*, in the before described machine, the mode of operation substantially as described, for drawing or rolling, to a cylindrical shape, the end of the stem of square bolts, by means of the segment rollers, in combination with the jaws, or equivalent therefor, on the sliding rotating mandrel, operated by an arrangement of mechanism such as described, or any equivalent therefor."

His second claim refers to taking the bolts (which are suspended by the heads) from inclined "feeding-ways" by an automatic "vibrating wing" and "transferring-pincers," one at a time, and placing it in the "jaws" preliminary to the rolling process.

There is no statement anywhere in the patent whether these bolts were treated cold or hot in 1855, the state of the art being at that time to work the iron heated for both heading and rounding the bolt blank from square rods, except the few short square-necked bolts made from round rods, by the upsetting method of Mr. Ward's previous machine. But the experienced iron worker, looking at the drawings and the description of them in patent No. 13,241, will conclude that it was not practicable to pass *heated bolt blanks* through the automatic feeding-ways and pincers to the rollers and have them very hot when they reached the rolls. But — and it was a serious but with Mr. Ward, as it was once with the writer perhaps, when he evolved a bright idea along in 1861 or thereabouts, of rolling the round stem on a square bolt blank quickly and noiselessly, by constructing a drum-shaped segment roller of cast iron with small transverse corrugations on the outer face part of the way around it, to rotate in front of similar corrugations on a fixed semicircular housing of the same thickness or depth of the roll, the two parts so set as to

present a slight taper to the opening between the roller and housing; the heated blank of square iron being fed into the machine parallel with the corrugations, expecting them to catch and *rotate* the bolt (they did that) and round the angles into a round stem. Instead of doing that, the blank came out a very tiny metallic wisp-broom. It was a hard joke on the inventor, but a bit of wisdom was gained that was valuable, and the experimental mechanism had not been of expensive construction. He learned what could *not* be done with a *hot rod*, and suspects that neighbor Ward found out what could not be done with a *cold rod* at that Anno Domini. The iron "split" or "slivered." The "Bessemer" process or the "Open Hearth" methods of making tractable bolt rods had not yet developed, although the Henry Bessemer patents for making iron or steel from the ore were issued in 1856; yet it took time, capital and experiment with ores and machinery, to develop the many wonderful achievements that are now but an every-day performance, with cold metals thus produced. Yet Mr. Ward had evidently adhered strongly to the utility feature of the short upset square bolt when pushed to the invention of 1855; and as his firm had not to a large extent (in my canvassing experience) invaded the great Western market between the Alleghany Mountains and the Mississippi River, he then leased some of his early patterned short, square carriage bolt headers to James Wood & Co. of Pittsburgh, who were manufacturers of iron — and it is my impression they were also connected with Knap, Wood & Co. in developing the "Carter" hot pressed nut machines, the patents for which Carter and Rees had taken out in 1851 and 1853, and had been trying to get the newly invented product upon the market.

In 1854 the writer launched out also into the then almost boundless West, passing Buffalo for the first time in seeking trade, and taking in the larger places to Chicago, and in the following year to the Mississippi River towns from Dubuque

to St. Louis, thence homeward via Cincinnati, Dayton, Columbus and Cleveland. My best recollection is that the Ward bolts and the hot pressed nuts of Wood & Co. did not cut much figure in competition at the time, but in 1856 the "Cole" patent at St. Louis was obtained, that used "two punches acting towards the center at once, and forcing the metal into the body of nut and then one punch backs out, the other goes through and drives out the wad." This machine was of the hot pressing variety, and as it saved the metal from the center of the nut which all other methods sent into scrap iron, it promised to sweep the market of all competition. He or we took early notice of this dark cloud rising in the West, as it really looked to overshadow our market and all other methods of nut making in particular; for the profit derived from the saving of the center punching thus forced into the body of the nut would enable that method to get rich while selling at the cost, or even less, of the other nut makers — theoretically stated.

I hastened to the consumers where the Cole nuts were introduced, and was not long in learning that his process made the iron so solid and hard and the surface in the hole of the nuts so chilled and hardened, that the threading was attended with much greater expense than in the other makes, and I found the same objection, in less degree, to the nuts made in the Carter machine by Wood & Co.; while I had succeeded in discovering the secret of *cold punching* of the center hole of the nuts in so smooth a manner as to disturb the fiber of the iron very little, and had no peer in that important feature among the cold pressed nut makers except The Providence Tool Company. Consequently, the large consumers soon found their interests promoted by remaining with us in their patronage, and the merchants naturally bought such goods as they found were in favor with the consumers.

The "hot pressed" nuts obtained large notoriety at the time of their introduction, by the *claims* of cheapness and of

superiority over the "cold punched" variety; but, as said, "the proof of the pudding is in the eating," so we who were interested lost no time in showing up the relative cost of threading the two kinds, with a large margin in expense of tool work in favor of using the cold punched nuts; and we challenged a comparison of the strength of these also, when in use—successfully for the old kind. The Pittsburgh firm was a strong one in capital, and in the Western market also, which was rapidly expanding its bolt and nut trade by the requirements of the numerous factories that were growing up there to make all manner of implements and machinery for the farmers' use; also the early construction of the railroads that were so soon to gridiron the grain fields of the West. But while all kinds of bolts and nuts had their favorites, the Russell, Burdsall & Ward short square carriage bolts, and the hot pressed nuts with Wood & Co. to back them, did not "mop" the old kinds from the field, even by a half cut into yet smaller fractions.

In 1856 Mr. Ward produced his patent, No. 15,861, for *forging nuts* by machinery. It was another innovation in that line that might have trouble in store for "the other fellows" (if a slang term of the time is permissible); but his firm kindly availed itself of the monopoly, and made its benefits accrue to their own bolt making specialty, and did not sell their machines to competitors.

The *nut making* branch of the bolt business was subjected to much tribulation in the decade following the advent of this invention for forging the nuts by machinery. The automatic hammering and the general process were asserted not to so chill the iron as to make the threading expensive as the hot pressed nuts had proved in the using. We who had started in the cold pressing method originally had survived the first shock from the "hot pressing" machines, and were now so soon to be laid out by the "hot forged nuts" sweeping the market. Inventors jumped to that idea as a "get-rich-quick"

opportunity. Mr. J. B. Savage of Southington, Conn., one of the early birds in the cold pressed nut business, threw some of his shekels into a new machine and patent in 1858, for hot forging of nuts, and was so sanguine that he soon sold some of his cold presses to Dwight Langdon, the bolt maker. But after a few years of experiment the hot forging machine was laid aside or furloughed, and he reinvested in more of the cold presses.

In 1859 Philip Koch of New Haven, Conn., brought out and patented another hot forging nut machine that made the goods, and again we of the old conservative method were put on trial for our business existence. The writer remembers having an invitation to witness this machine when in operation by the inventor, as he desired to market machines—not being in the bolt or nut trade. We saw much of merit in this exhibit of new mechanism, but between a feeling of some undeveloped trouble in the use of this machine on the one hand and the very satisfactory condition of our trade with our established methods of manufacture on the other, we concluded to cling to the cold presses as likely to survive yet awhile longer.

After Mr. Koch had sold a few shop rights or machines in Pennsylvania and New York, Upson & Dunham, with three other friends in Unionville, bought up the remainder of the Koch patent rights, in 1863 or thereabouts, and started an informal Union Nut Company to manufacture nuts by this process, and the next year were incorporated under that name. Mr. Koch got another patent in 1863, which also went to this company, Upson & Dunham being the chief operators until 1865, when Mr. Dunham sold his interest in Upson & Dunham to Mr. Upson and went by himself, being a mechanical man; and in a little while he brought out a new patent hot forged nut machine of his own invention, having had a year or more of experience with the Koch. This happened June 27, 1865, and was followed by another patent November 14,

1865, for an improvement on the first; and on August 6, 1867, by another patent in the same line; and in this last year, The Aetna Nut Company of Southington, Conn., was organized, to manufacture hot forged nuts by the Dunham machines. This looked like trouble again, and it came pretty soon, but not so much as might have been to the cold pressed nut makers.

The Dunham machine seemed to have "the middle of the road" as a graceful worker and fruitful in product. Neither the Ward nor the Koch could stop it, and its patron, The Aetna Nut Company, was a hustler.

The "Savage" was quietly resting in a barn for some years past. As quietly The Union Nut Company made an offer for the neglected relic of high hopes but low profits, as a speculation, and got it with all of its rights. A reissue upon a trifling moving of the nut, as shown in the drawings, but not covered in the claims of the Savage patent, was obtained; then the game stood thus: Mr. Ward's patent of 1856 was held to tie up the Koch and with it The Union Nut Company; then The Union Nut Company with the Savage could tie up the Dunham, which last was launched right into business with a vim beyond any former experiment in this line. The triangular contest was amusement for those who had nothing invested in it; but the situation could not last always where the stake was considered of so great importance by the actors in interest. The Union Nut Company, which at that moment seemed to be pretty nearly on the cold side of the situation, had two men in its management who had to be reckoned with when diplomacy was the game: Samuel Frisbie and Andrew S. Upson were on guard in that camp, and talent was required to escape from the prior patent of Ward, with their Koch investment. The "Napoleon of Finance" had not yet emerged from short clothes, nor the Northern Securities method been invented ready to hand; but that was just very near what these diplomats fixed up. It was called the

“Consolidated Forged Nut Co.,” with the holding capacity of one hundred thousand dollars in dimensions, and to fill this cavity Mr. Ward (it is supposed) was invited to chip in his basic patent on hot forged nut machinery, with the pair of patents held by The Union Nut Company people to fill up the “holding” and fighting machine, that could then be trained against the Dunham patent if this should not be in like manner absorbed by diplomacy. It is easy to see that when Mr. Dunham found the entire field of older patents in this class marshaled against him, discretion led him to yield to the diplomats also and accept a share in the then ponderous looking Consolidated Nut Company, with its promise of large returns from its now four-sided monopoly.

Time is a great leveler in affairs terrestrial, and many times phases hopes or fears so they look quite differently, and so it was with The Consolidated Nut Company holdings. The expected boom in selling machines at marvelous prices did not arrive, but the patents were all safely stored, and The Union Nut Company was busy at bolt and nut making at the old stand without a cloud in its sky. It was said The Aetna Nut Company had to apportion some of its stock to the “combine” to soothe its managers for the great mental strain they had suffered in catching it, and to permit it to go in peace henceforth.

After a time Mr. Ward seemed to be weary of carrying the slim profits of the “Consolidated” company and sold his stock in it to The Union Nut Company people, and later Mr. Dunham did likewise for a sum that he once told the writer was trivial in comparison with the value of the patents that he had thus parted with.

The Consolidated Forged Nut Company stock had thus all become absorbed by The Union Nut Company owners, and it seemed to be a singular coincidence that the market soon opened for the Dunham machines, and the bolt makers of the country were climbing over one another to get the very first

deliveries, even at prices known to be fabulous profit to the vendors. (The writer's impression at the time was that The Consolidated Forged Nut Company, chartered October 31, 1868, with one hundred thousand dollars capital, and but two thousand dollars paid in on January 9, 1869, was not so much for nut making as for patent holding, and *brain work*, and that the best of that quality was under two hats in Unionville. The sequel seems to have justified his thoughts.)

Our firm was becoming somewhat inoculated with the "hot forging" views too; but the majority, with the writer, believed in and adhered to the old plan of well made cold pressed nuts in our increasing bolt business up to 1871, when he retired from the management, and Clark Brothers & Co. being then formed, continued the old business.

Again, in retrospect of the carriage bolt manufacturing from 1856: While The Plant Manufacturing Company had absorbed The Bristol & Moss Company and L. Clark & Co. (the successors of Clark, Norton & Co.), and were crowding hard upon The Miller Manufacturing Company and L. B. Frost & Son, and rapidly expanding their facilities to do the lion's share of the bolt making of the country, it is fair to say that they were then "in the swim" to do so, had they devoted a more critical attention to the quality of workmanship upon their product rather than the quantity of their output. This neglect promoted a demand for better bolts on the part of the carriage makers, who were rapidly becoming large consumers, and the Philadelphia Norway iron bolts, then being made in a limited way for the home trade, glided gracefully in to meet the demand, and grew with its growth to such magnitude that ere long the Plants had fallen out of first rank in volume of the carriage bolt business of the country never to regain it. Verily,

“ There is a tide in the affairs of men,
Which taken at the flood, leads on to fortune;
Omitted, all the voyage of their life
Is bound in shallows and in miseries.”

It is a sad duty to record it, but history is as inexorable as the fates of Greek or Roman mythology. The Miller Manufacturing Company failed in 1857; Langdon suspended; Frost & Son were cramped financially for a time, and it became apparent later on that the Plants Company had passed the zenith of their prosperity. Other firms had come on and builded for a more favorably enduring reputation, and in a few more years the scepter of their bolt making superiority had departed to other establishments. One little episode of their business life I may relate. During the winter of 1857-8, when the panic had suspended about all of the banks in the Western States and many elsewhere. On one occasion a deep snowfall came, with a gale, that drifted the railroad cuts full, broke telegraph wires, and for two or three days neither rail nor wagon roads were passable. The Plant Manufacturing Company had a note fall due at the bank in New Haven, twenty-one miles distant, during this embargo. No cars, no telegraph, no horse road open. A trusted clerk was sent from their office *on foot* with the necessary funds to meet the obligation, and Charles Blakeslee did it. He at least should have a statue!

As the writer recalls the conditions in the bolt market at or about that time, with reference to the Russell, Burdsall & Ward inventions, that firm had grown up quite a goodly trade in stove rods and bolts and square countersunk head bolts for the old style plows, this being largely in the Eastern and Middle States. They made those articles in the best manner of workmanship, and the short upset square neck carriage bolt was a feature in that trade, but it did not compete in the gen-

eral trade so as to attract our notice much for several years. But after a refreshing of old memories, and studying anew the Ward patents of 1855 and 1863, for making the long square bolt, and being personally conversant with and in the market all of those years, it is our impression that the Russell, Burdsall & Ward carriage bolts did not disturb us much until 1863, when Mr. Ward obtained patent No. 38,518, for rolling the barrel on carriage bolts which "require a square shank, *from cold iron*." This left nothing obscure as to what it proposed to do (unlike the one No. 15,861, issued in 1855, presumably with the same intent). It completed the process of *cold forging* of carriage bolts from *square iron*, and the patented machinery for it gave Russell, Burdsall & Ward a monopoly of it for seventeen years.

The claim for this machine is very lengthy and technical, but we quote a clause that is significant of difficulties overcome since the patent of 1855 was issued, to wit:

"This machine is constructed for making bolts which require a square shank, from cold iron. Square iron is taken of the size of the shank required, the head swaged, and the part on which the screw is to be cut, drawn down to the required size by a pressure so applied as to *prevent the disintegration or splitting of the iron*."

The italics are the writer's, to emphasize the *splitting of the iron*, now prevented, as indicating that the patent of 1855, for "rolling the end of the stem of square bolts by means of the segment rollers," was unsuccessful; and being a contemporary in the carriage bolt market, he holds this to be the date of Russell, Burdsall & Ward's establishing their full "long square" bolt. This improvement in their method of bolt making may very likely account for the surrender and return to them soon afterwards of the "short square" headers used by James Wood & Co. of Pittsburgh, and the latter firm with-

drawing from that branch of business. That form of short square bolt has retained its use by some special customers up to this time, and owing to smaller cost of making it may continue in the market. But Mr. Ward's triumph, in the feat of bringing out a carriage bolt headed and rounded, without heat, from square iron, treated by automatic machinery, placed him at the front of inventors in his line, and he survived to see a factory with acres of machinery of his creation daily turning out tons of bolts with a facility and precision fascinating to behold.

The state of the bolt making art from 1863 developed rapidly in new and improved mechanisms, and processes of manipulation; the "Clark" patents and process of "lateral swaging" the square neck on a round rod of iron at same time of forming the bolt head at no extra expense save the die making, has been noticed already — he distanced competitors in the rapidity of production — that counted forcibly on the cost of output. His methods were adopted so generally by the common bolt makers that suits were finally instituted about 1871 and other steps taken to enforce his rights under his patents. Two or three years were thus consumed in taking evidence and preparing for a battle royal to test the validity of Mr. Clark's invention. The first case that came up was against Lamson, Sessions & Co. of Cleveland, Ohio, as he had sought to meet the largest infringer so that if he won against an able competitor, it might count for something and shorten the contest with others. This case was finally reached, but the night before the opening of the court found both contending forces in the New Haven House at New Haven, Conn., ready for the morrow. The opposing attorneys had an evening together and presumably made an unofficial, or confidential "show of hands." The result was a compromise plan for a settlement, the paying of a royalty on sales, for a license to L. S. & Co., the early forming of a bolt association to include all of the infringing parties desiring to pay

an agreed royalty, and to prosecute any infringers remaining outside of the associated licensees. The royalty upon gross amount of sales was fixed at two per cent.; all sales to be reported to Mr. Clark quarterly under oath and the two per cent. royalty paid. The firms joining in this association numbered eight, and it was organized as The American Bolt Association at a meeting held in New York for that purpose, and the following officers elected: President, Orson W. Stow, Plantsville, Conn.; vice-president and agent, Wm. J. Clark, Milldale, Conn.; secretary, S. W. Sessions, Cleveland, Ohio; treasurer, L. M. Dayton, Cincinnati, Ohio.

Mr. Wm. J. Clark was made the agent to receive all reports of sales quarterly and adjust the proportions and amount due to each firm, and cause the balance to be settled by an agreement. This was made March 26, 1875, as quite two years had been consumed in the litigation with Lamson, Sessions & Co., and thereafter much time was consumed in obtaining a reissue of Mr. Clark's first patent, to get a better description of his invention. That was accomplished February 16, 1875, and the association was set agoing in the following month, as above noted.

The firm of Lewis, Oliver & Phillips of Pittsburgh, Pa., who were held to be using the Clark invention for bolt making, declined to enter the Association and denied Mr. Clark's claim to the invention and persisted in the use of the method.

The Kennedy Company of Plainville, Conn., also were using two machines of their invention that were held to infringe the Clark patent.

Suits were instituted against both of the above firms, and the Kennedy suit was the earliest ready and tried out in the United States District Court at Hartford, Conn. The validity of the Clark patent was sustained, but the particular mechanism used by the Kennedys was held by the court to not be an infringement and the cause was dismissed.

The case against Lewis, Oliver & Phillips was then pressed as rapidly as it could be got ready. Testimony was taken before United States commissioners at sundry times at Pittsburgh and Cleveland and a strong effort was made by the defendants to break the Clark patent by exhibits of mechanism and methods to show their priority over the date of his invention, but Mr. Clark proved to be both a veteran bolt maker and an early bird in devising this and other new machinery to improve and cheapen the manufacture of bolts and nuts. His knowledge of the state of the art in the country was so complete that his attorneys could readily analyze to the hardpan of any testimony presented, and when it all was ready to be submitted on the following day to the court, the defendants expressed a preference for a settlement and a license, if it could be negotiated, rather than persist in the trial before the court.

The Association was agreeable to this course, if the terms of settlement could be agreed upon, as much cost had accrued in preparation of the case thus far. That part being adjusted between the parties, the suit was discontinued, and Lewis, Oliver & Phillips became members of The American Bolt Association, April 20, 1877, with $13\frac{1}{2}$ shares on a recapitalization of 108 as a total of the shares, and they were to have a license at the same royalty as the other members.

F. M. Haslett, also a bolt maker in Pittsburgh, Pa., was prosecuted for infringing the Clark patents, and enjoined after a trial and a vigorous defense in court. He then changed his method of manufacture.

Several small makers of bolts were notified of infringements and after investigations they ceased to infringe or paid a sum agreed upon.

The prices on the Clark bolts were fixed in the Association and enforced under a forfeiture of the license of the party for wilful violation.

The Association agreement expired February 1, 1881, as that was the limit of the patent. The sales of this class of

bolts under the Clark patents had reached nearly one million of dollars per year, and while it was Mr. Clark's programme to use his patent monopoly with moderation as to prices, he insisted on an honest maintenance of the rates and thereby securing a fair and steady profit to the licensees. So agreeable was the result to them that they attempted to continue the Association longer among themselves for mutual benefit; but my recollections of the affair are imperfect as I ceased to be a party, and the bond of the patent being released, it is my impression that it was not a long time ere the prices became very irregular. It is comparatively easy to maintain "gentlemen agreements" when the demand exceeds the supply; but when the reverse occurs, the agreements fracture too easily.

The next stage of endeavor of Clark Brothers & Co. was to develop the application of "*cold forging*" of carriage bolts from *round iron*, as Mr. Ward had for a long time worked his patented method upon square iron, and had won a lasting reputation for his product.

Mr. Wm. J. Clark, the founder of this establishment, had succeeded with the *hot forging* of the *round iron carriage bolt* for a generation and the time seemed ripe to try a cold forging process on their favorite round iron carriage bolt.

The improvements in mixing ores and manipulation had produced iron rods of much more ductile quality than in the earlier years of the art, and they began the experimental stage of cold forging with the assistance of Mr. Wm. H. Hitchcock, a machinist many years in their employ. The development was attended with trials and failures, and then changes of mechanism and more trials, along about 1890 or 1892, and much expense and time applied for about two years, before success was considered complete. The product was finally a perfect beauty for a bolt, and it is not my province to elaborate this article more, preferring to let the present day market testify as to the merits of "Clark Brothers' Bolt Co.'s" *cold forged carriage bolt from round iron*.

I preferably would avoid incorporating that which appears like advertising material, into a historical work, but deem it only justice that the record should show to those who come upon the stage of life after the present actors have passed over to the other side, that Clark Brothers & Co. had blazed the way to practical results in the cold forging of carriage bolts as above related, and that the mechanisms, the process and the skill, which they cultivated and developed at much expense, had become a substantial advantage to many other manufacturing establishments without compensation to them, other than the consciousness of having become, by their own living, large benefactors to the public.

Now, as I terminate this medley of historical and reminiscent recital, and stand just midway in my eightieth year and look down the line of my compeers in the business in the years long past, I can send a friendly greeting to only a few at this date. Of those who embarked in this business in the early "sixties" and who might then cause me trouble, or render assistance, I am glad to greet as now living, O. C. Burdick, the inventor of bolt and nut machines, and R. S. Plumb of Buffalo (his old-time partner).

Also Wm. J. Lewis of Pittsburgh (also an inventor of valuable bolt machinery) and one of his partners, "Jimmie" Oliver, now in the full fruition of his activities and directing a great business, grown up from the little seeds of skill and energy planted in Pittsburgh by the quartet of partners in 1863.

Now as I pass down the line beyond 1860, greetings are extended to George Dunham of Unionville, the inventor of the useful nut machines, both hot and cold methods; also Charles H. Graham, manager of The Upson Nut Company factory in Unionville, both of these were pioneer workers in the Langdon bolt factory there.

It also affords much gratification to extend a hailing salutation now to Mr. Isaac P. Lamson as one of the veterans

in the carriage bolt-making industry, first with the Henry A. Miller firm in the early '50s, later The Miller Manufacturing Company; then with the Plant Manufacturing Company, and later, graduating as a foreman with Wm. J. Clark & Co. to embark with his brother, Thomas H., in the formation of the firm of Lamson, Sessions & Co., which firm has achieved an enduring place in the bolt manufacturing industry of the country as is duly recorded in this volume, and as the sole survivor at this time of the original four partners, may he live long to enjoy the fruits of an industrious and honorable business career, and rounded out by becoming the chief sponsor for this volume in order to preserve a record of the rise and progress of the bolt and nut making art in this country.

Coequal with Mr. Lamson in longevity, and an interesting and uncommon circumstance to mention, the three Clark brothers who united their means and energies in 1854, as already related, to prosecute to a greater degree the bolt and nut business, which the senior brother (Wm. J. Clark) had planted the germs of in 1850, are all surviving and active and the business then established has been a continuous success for the half century now past, although the elder brother has retired for a well earned freedom from the exacting cares of a live manufactory.

The two younger brothers have continued to manage the business to this date with such assistance as they have from time to time educated and incorporated into it.

Although the youngest is 72 years of age, and served a term of enlistment in the Civil War, he has now been called for the third time by his townspeople to represent them in the General Assembly for the session of 1905, his activities seeming in demand to promote the general welfare.

Next, and early in the line in the Langdon factory, we now greet the youthful "Bolt Pedlar" of the days of long ago, Hon. A. S. Upson, the chief of The Upson Nut Company, who combined ripe judgment with perseverance to such an

extent that he usually got what he wanted; and if he and Mr. Plumb did at times cause the writer some anxiety over fractured "Discount Sheets" when the American Bolt Association was in later years, the subject of our care and protection, we have long ago forgiven them and wish them prosperity all along the declining years to the end of life's chapter.

Of the skilled workmen prior to 1860, Willis B. Smith, once our chief blacksmith and die maker, is now enjoying a well earned rest in his old age, with a son at Worcester, Mass.; and Daniel A. Watrous, a mechanical handy man of good qualities and previously noticed in our sketch and who emphasized his patriotism by enlisting in the Civil War of 1861 to 1865, and worked for us both before and after that event, is now happily resting from his activities in that haven for the worthy old soldiers, "The Soldiers' Home," at Noroton, Conn. May both of these enjoy their well earned rest, until the final summons shall call them to the other shore.

To Erastus W. Pierce, of our mechanical staff of 1860, and later, we extend greetings while enjoying his declining years at agricultural opportunities on a farm provided by his son in Shelton, Conn. He should have the pioneer medal for making our first "Double Stroke Heading Machine."

His son Eugene, then a lad just out of school, was placed in the boys' department and given opportunity to develop his qualities in the mechanical line during the five or six years of his father's employment with us. That he made good use of his talents is demonstrated by the fact that his skill and industry have lifted him step by step to the result that he is now one-fifth owner of the "Standard Horse Nail Company" of New Brighton, Pa., with a paid-up \$500,000 capital, and is the principal owner of the "Brighton Gas Engine Company." May his success be enduring.

One or two years prior to the employment of the Pierces, we had taken into the factory a couple of lads in their minority who have made their way in the world and are yet among

us to enjoy it; one was Leroy S. White, who served his first mechanical training in 1859 to 1864 in our bolt works with flattering success; but afterwards preferring other lines in mechanics, graduated at the "Die Sinking" branch of "Drop Forging" at H. D. Smith & Co.'s factory at Plantsville, Conn., and later on with a mechanical shopmate (John H. Swift) went to Union, Broome County, N. Y., and with a little local aid started a new factory called the "Union Forging Company," that has proved a very successful enterprise under their management and a comfortable provision is assured them for the evening time of life.

The other lad, "Willie Wilbur," was a "nubbin" of a boy, whose qualities could not be measured then with one eye; the boy's work seemed but play to his deft fingers, and later on mechanical development seemed his natural food, and several years afterward, when he had transferred his services to Lamson, Sessions & Co., at Cleveland, Ohio, and had grown into responsible mechanical position, he was intrusted to secure exact knowledge regarding the bolt machines of Lewis, Oliver & Phillips, of Pittsburgh, so that it could be determined if they infringed the Clark patents, leased to the American Bolt Association in 1875.

His inspection, and subsequent examination thereon before the Court, was so clear in the mechanical detail that Mr. Lewis, one of the defendants, was prompted to exclaim at its close that they would admit all that he had said, and that they would try the case on its merits; a cross-examination would have been useless.

That youngster has become the mechanical head of one of the great bolt works of the country, The Lamson-Sessions Co., and he is also the industrious, painstaking, persevering compiler of this history, and I gladly offer my tribute of thanks that he has been willing to devote his time and talent to perpetuate to posterity the rise and progress of this, one of the important arts in this country.

GENERAL SUMMARY.

When bolts and nuts were first made and brought into use is not known. The early method of making them was to forge the blanks on an anvil and then to form the threads by the filing process. The first application of machinery to making screw-threads was made in France in 1569 by Besson, who contrived a screw cutting gauge to be used in a lathe. In 1641, almost a century later, this device was improved by Hindley, of York, England. This method of chasing threads with comb-like hand tools came into general use and for many years was employed for making small screws. The first English patent was issued to Job and William Wyatt, May 14, 1760, for three machines; one for making blanks, another for nicking or slotting the heads, and a third for cutting the threads. Between this date and 1840 some ten patents were issued in England. Early in the nineteenth century, Sir Samuel Bentham, one of England's greatest mechanical engineers, devised a machine for cutting screw threads with rotary cutters, which he did not patent.

The only one of the ten patents mentioned worthy of notice, and that solely for the principle involved, was that of Miles Berry, dated Jan. 28, 1837, which was for a gimlet pointed screw. This machine was of no practical value, further than to form the basis upon which many of our modern automatic machines have been built.

The first American patent for screw machinery was issued Dec. 14, 1798, to David Wilkinson, a celebrated mechanic of Rhode Island, followed by a patent of the same nature, dated March 23, 1823, issued to an equally distinguished mechanic of Massachusetts, Jacob Perkins, of Newburyport. On May 4th, of the same year, a patent was granted to Jacob Sloat of Ramapo, N. Y. These various patents were the original inventions that gradually developed in after years into our automatic shavers and slotters, threaders, pointers, tappers, etc.

Cold forging in America had its origin at the iron works of the Piersons', established at Ramapo in 1798. At these same works Thomas W. Harvey, in 1831, applied the toggle joint to a heading machine for making spikes, screw blanks and rivets. In 1834 Mr. Harvey formed a co-partnership with Frederick Goodell and established a small screw factory at Poughkeepsie, N. Y. In 1835 Mr. Harvey further improved the heading machine, and also the shaving and slotting machines.

Jacob Sloat and Thomas Springstein also contributed to the improvement of automatic machines.

In November, 1836, patents on thread cutting machines were issued respectively to Henry Crum, of Charleston, N. Y., and to J. H. Pierson, of Ramapo, N. Y. Mr. Pierson's machine was put in successful operation at the Ramapo Iron Works, making wood screws.

In 1838 Clement O. Reed and others organized the Providence Screw Company of Providence, R. I. Mr. Reed further improved the machine. The Eagle Screw Company of Providence was organized during the fall of the same year and purchased a part of their machinery from the former company. This machinery proved to be an infringement on Pierson's patent.

In 1846 Thomas J. Sloan of New York improved automatic machinery and in 1849 the machine known as the Cullen-Whipple machine, patented August, 1842, was improved and simplified by the New England Screw Company. Mr. Whipple's machine for shaving the heads and slotting was patented April 6, 1843, and the device for removing the burs left from the rotary saw in cutting the slots in the heads on April 19, 1843. In 1853-54 and '56 Mr. Whipple invented and patented seven other devices and machines for heading and finishing screws.

In 1852 the Bay State Screw Company was organized at Taunton, Mass., which engaged chiefly in the manufacture of rivets, machine screws, stove and tire bolts.

In 1856 the American Screw Company, Providence, R. I., was organized with \$1,000,000 capital.

In 1860 The Bay State Screw Co. was purchased by the American Screw Co., who continued the manufacture of the same line of goods with increased facilities, introducing the rack and pinion automatic tapping machine originally used with shake feed, constructed on the same lines and in the same manner as the old-fashioned shake hopper for feeding grain to mill stones for grinding meal or flour. This feeding arrangement was subsequently improved by substituting the swing or lift feed now in use. The American Screw Co. also introduced thread rolling which they have gradually improved on until it now bids fair to entirely supersede the old process of thread cutting with dies or tools. They have a spacious apartment in their New England works on Eddy Street, Providence, used exclusively for a museum, in which there is an interesting collection of machines, tools and devices, numbered and catalogued, beginning with those of the earlier American inventors, including those of Sloan, Crum, Pierson, Harvey, Whipple and many others, which show the improvements of wood screw and rivet machinery step by step for more than half a century, and which have ultimately been introduced into general use in modern bolt and nut works in the manufacture of stove, tire, carriage, machine, lag and coach screws. This collection is not only unique and of great interest to the curious mechanic, but is of great value as showing the rocks on which many have split and the reasons for failure in many devices. These various machines, though crude and inoperative as a whole, nearly all contain some device or peculiarity of adjustment that was the germ or suggestion of valuable ideas to experts in this class of machinery.

After the expiration of these various patents, about 1870, Asa S. Cook, of Hartford, Conn., commenced the manufacture of various perfected automatic machines and placed them on the market. Mr. Cook provided the threaders, shavers,

slotters and pointers with rotary hoppers, and they became generally known as the Cook machines. At about the same time, or a little earlier, The Waterbury Farrel Foundry & Machine Co. of Waterbury, Conn., began the manufacture of automatic cold heading or forging machinery and thread rolling machines, cold pressed nut machines, etc. Improvements have been made from time to time until, with the introduction of bright and annealed bessic steel wire, the various styles of single stroke, solid and open die, double stroke, solid and open die, and triple stroke heading machines have come into general use and are rapidly taking the place of hot forging. Bolt machinery originated and developed with the business of wood screw manufacture and eventually became used in the manufacture of bolts which had its origin as a business in America at Marion, Conn., in 1839.

Nut manufacturing was begun in 1835, when Jeremiah O. and Joseph Arnold established a cold pressed nut business in a small factory on the Moshassuck River, Pawtucket, R. I. They were the pioneers in this branch of manufacture. The records show, however, that a patent was issued to J. Rewey, Berkshire, N. Y., May 11, 1811, for a machine for cutting off bolt ends, and that J. Bellemere, Philadelphia, Pa., was granted a patent, Sept. 25, 1839, for a mode of squaring and finishing the heads of bolts.

The first patent of importance was granted to Micah Rugg (Marion), Southington, Conn., Aug. 31, 1842, for a machine for trimming the heads of carriage bolts and the first of the kind ever used for that purpose. Mr. Rugg opened a blacksmith shop in Marion in 1818, and made bolts as they were wanted at an average price of 16 cents apiece. In 1839 he commenced the manufacture of carriage bolts for the trade, being the first to offer them in the market as an article of merchandise. In 1840 Mr. Rugg formed a co-partnership with Martin Barnes and built the first exclusive bolt and nut factory in America, at Marion, Conn.

The first power used by them was a treadmill propelled by a bull, which was employed to blow the fires. They owned, however, a valuable water privilege at their very door, which was subsequently utilized to advantage. Rugg & Barnes employed six men, who produced 500 finished 5-16 carriage bolts per day, costing at the rate of \$12.50 per 1,000, for labor, the selling or exchange value of which was \$30.00 in assorted lengths. Taking 5-16 x 3 inches as an average, the selling or exchange would be \$33.00 per 1,000. At the present writing the same sell for \$3.60 per 1,000, and 2,000 bolts per operator is a fair daily production, which includes boy, girl and men operators.

In 1840 William Golcher started making carriage bolts in the basement of his residence, on Front Street, West Philadelphia. He imported the first English Oliver brought to America and installed it in his workshop.

The Providence Tool Co. of Pawtucket, R. I., was founded. It is now known as the Rhode Island Tool Co. of Providence, R. I.

In 1842 L. B. Frost & Son began manufacturing bolts in Marion, Conn.

Micah Rugg patented a bolt head trimming machine on Aug. 31, and invented his treadle heading-vise.

Martin Barnes invented his tail-screw-reverse solid die thread cutting lathe.

In 1843 Alfred Hotchkiss sold his first bill of carriage bolts in New York City, selling them in small lots, on commission, subject to unconditional sales.

Martin Barnes invented his rounding press, known as "The Rattler."

L. B. Frost & Co. introduced the turning of carriage bolt heads.

In 1844 A. P. Plant & Co. issued the first printed price list. It was printed on a 4 x 6 inch card. During the same year they began putting bolts in paper packages of 50 and 100 each, suitably labeled.

A. P. Plant & Co. sold their first bill of bolts in Boston, Mass., to Dodge & Co., introducing the trade in that city.

Capt. Julius B. Savage began manufacturing cold pressed nuts, exclusively for the market, introducing the Allen & Atkins press for the purpose, which was the first application of machinery to this class of work in Connecticut.

In 1847 Russell, Burdsall & Co., of Portchester, N. Y., introduced stove bolts and rods to the stove makers of Albany and Troy, N. Y.

In 1848 a patent was granted W. Grant, of Boston, Mass., on a bolt heading machine that was never placed on the market.

In 1849 J. King, Bordentown, N. J., patented a machine for dressing nuts and bolt heads.

In 1850 W. E. Ward, of Portchester, N. Y., invented an open die bolt and rivet machine, for the manufacture of bolts, stove rods, screw blanks, rivets and other similar articles of metal.

W. J. Clark introduced special plow bolts for steel plows.

In 1851 N. Starks, of Albany, N. Y., invented a bolt heading machine which never came into general use.

W. Kenyon, Steubenville, O., secured a patent on machinery for making nuts and washers, which never reached the market.

D. L. Weatherhead, of Providence, R. I., patented a heading machine which was never utilized to any extent.

The bolt manufacturers association was formed and a uniform list of prices was adopted.

Henry Carter and James Rees secured the first patent issued on a hot pressed nut machine.

In 1853 Henry Carter and James Rees secured a second patent on the Carter hot pressed nut machine, and opened a factory in Pittsburgh, Pa.

The Plant Manufacturing Company was organized and installed their first automatic tire-bolt heading machine.

In 1854 Sir Joseph Whitworth effected the "Whitworth standard" of screw threads.

In 1855 The Plant Manufacturing Company introduced the "bed screw" heading machine for forging heads on carriage bolts.

J. T. Wilmarth, Northbridge, Mass., patented a die for making bolts which proved of little value.

R. Crichton, Buchanan, Pa., patented a bolt making machine that was practically a failure.

William E. Ward perfected and patented a rolling machine for rolling the stem or barrel of carriage bolts from square iron. This was the introduction of automatic feeding, in carriage bolt machinery, by suspending bolts by their heads and delivering them from inclined feed ways and transferring spring nippers.

Adolph Frienck invented and constructed what came to be known as the Chapin Header, at Taylor & Whiting's Machine Works, Winsted, Conn.

In 1856 Herman Chapin and H. B. Kellog & Co., under the style of Pine Meadow Machine Company, New Hartford, Conn., built their first heading machine, known as the "Chapin header."

Samuel Coleman introduced the manufacture of carriage bolts in Cincinnati, O.

William E. Ward invented his forged nut machine.

Richard H. Cole, of St. Louis, invented a hot pressed nut machine.

The Wood heading machine was invented in Pittsburgh, Pa.

Henry Bessemer patented the process of making soft, open hearth steel, which paved the way to the process of cold forging.

H. M. Clark, New Britain, Conn., patented a bed-screw forging machine, which was afterwards adopted for bolt heading by The Plant Manufacturing Co. of Plantsville, Conn.

In 1857 Russell, Burdsall & Ward began manufacturing carriage bolts entirely by the cold forging process, and also introduced stove bolts with shaved and slotted heads and shaved tire bolts.

In 1858 Capt. Julius B. Savage invented a hot forged nut machine.

John Greben introduced his heading machine and commenced the manufacture of stove rods in Pittsburgh.

In 1860 W. J. Clark invented a double stroke heading machine, for forging plow bolts and square head machine bolts and coach screws, off the rod.

In 1861 O. C. Burdick made models for his hot pressed nut machine.

In 1863 Philip Koch, of New Haven, Conn., invented the "Koch" forged nut machine.

W. J. Clark invented his concave bolt.

O. C. Burdick patented his hot pressed nut machine.

In 1864 James Minter, Worcester, Mass., invented a bolt head forging machine, operating hammers, for forging machine bolts.

W. J. Clark patented a method for making bolts from round iron and also dies for the same purpose.

William Sellers, of Philadelphia, perfected the "Franklin Institute" screw thread which was adopted as the United States standard thread and came into general use in this country.

In 1865 George Dunham patented the Dunham forged nut machine.

O. C. Burdick patented his bolt forging machine.

William J. Lewis invented the "Lewis" Pittsburgh heading machine.

Geo. H. Fuller brought out his first forged nut machine.

In 1867 J. H. Sternbergh patented his hot pressed nut machine and introduced chilled box dies; also method of grinding the same.

The Aetna Nut Co., of Southington, Conn., was organized.

Wilbur F. Swathel patented his double clapper bolt heading machine.

In 1868 James B. Clark, Southington, Conn., invented a cold upsetting machine for forming blanks from round iron to be forged into full-square carriage bolts.

Franklin B. Prindle, Southington, Conn., patented a machine which made full-sized carriage bolts of a superior style and finish, but the machine was so complicated that it proved a failure.

In 1869 James B. Clark's cold upsetting machine was successfully used at The Plant Manufacturing Company's works, Plantsville, Conn.

In 1870 O. C. Burdick's steady motion heading machine for carriage bolts.

J. Noyes Smith's hot pressed nut machine was introduced.

In 1872 H. R. Blakeslee built his forged nut machine.

The Durrell revolving nut tapper was introduced to the market.

In 1875 O. C. Burdick Advance bolt forging machine.

W. J. Clark's combination agreement signed March 6th.

In 1880 James B. and Lucas C. Clark's full square carriage bolt heading machine introduced at L. D. Frost's, Marion, Conn., and Pillow & Hersey, Montreal, Que.

In 1884 O. C. Burdick rod heading machine.

In 1886 Harry Markham perfected his forged nut machine, which made two nuts at each operation. It was operated with some success at The Oliver Iron & Steel Company, Pittsburgh, and then taken to England.

William E. Ward automatic cold nut press, for hexagon and square semi-finished nuts.

In 1887 The American Screw Company introduced automatic, three-blow heading machines, which headed, punched the slots and pointed the blanks at a single operation. They also perfected their roll-threading machine. The operation of these two machines delivered gimlet-pointed screws, entirely completed. The peculiarity of this threading machine is that both thread forming dies move in opposite directions and reciprocally, thus avoiding the retarding friction incidental to machines with but one die moving. The process was invented by Charles D. Rogers.

George Dunham automatic cold nut press.

In 1891 The American Screw Company patented corrugated tire bolts.

In 1897 D. N. Bassett, Birmingham, Conn., changing his system of heading to drop hammers.

In 1900 George Dunham automatic cold nut machine for semi-finishing and also a complete system of machinery for finishing hexagon and square nuts.

In 1902 The Lamson & Sessions Company averaged 3,000,000 bolts per week during the year.

In 1903 The Ohio Bolt & Nut Co. organized and building new factory at Berea, Ohio.

The Lamson & Sessions Company give ten hours' pay for nine hours' work.

Since the introduction of the bolt and nut industry by Micah Rugg, in 1839, the business has expanded and increased until at the present writing, 1905, there are five hundred and ten establishments in America which are engaged in the manufacture of bolts and nuts, which number includes manufacturers of bolt and nut machinery. In the greater number of cases, however, this line of manufacture is merely a subordinate branch of the general business of the companies.

LIST OF MANUFACTURERS.

A

American Iron & Steel Manufacturing Co., Lebanon and Reading, Pa.

Ames, W. & Co., Jersey City, N. J.

American Bolt Co., Lowell, Mass. (Removed to Birmingham, Ala.)

American Nut & Bolt Co., Cleveland, Ohio.

Atlas Bolt & Screw Co., Cleveland, O.

American Screw Co., Providence, R. I. (Tire and Stove only.)

Acme Machinery Co., Cleveland, O. (Bolt and Nut Machinery.)

Ajax Manufacturing Co., Cleveland, O. (Bolt and Nut Machinery.)

Allegheny Forge & Iron Co., Allegheny, Pa.

Aetna Nut Co., Southington, Conn.

B

Brown Co., The H. B., East Hampton, Conn. (Bolt and Nut machinery.)

Buffalo Bolt Co., Buffalo, N. Y. (Works at Tonawanda.)

Boston Bolt Co., Boston, Mass.

Bassett, D. N., Shelton, Conn.

Berry Bros., Columbus, Ohio.

Bettscher Manufacturing Co., Cleveland, Ohio. (Small nuts and washers only.)

Baltimore Bolt & Iron Works, Baltimore, Md.

Blake & Johnson, Waterbury, Conn. (Manufacturers cold forging bolt, screw, rivet and nut and washer machinery.)

Bourne & Knowles Mfg. Co., Cleveland, Ohio.

Burdick, O. C., Buffalo, N. Y. (Bolt and nut machinery.)

Brohard Co., Philadelphia, Pa. (Expansion bolts.)

Brown & Co., Paris, Ont.

Brantford Screw Co., Ltd., Brantford, Ont.

C

Capital Manufacturing Co., The, Chicago, Ill. (Automatic nut tappers.)
Cowles, C. & Co., New Haven, Conn.
Central City Bolt Co., Syracuse, N. Y.
Columbus Bolt Works, Columbus, O.
Clark Bros. Bolt Co., Milldale, Conn.
Cobb & Drew, Plymouth, Mass. (Rock Falls, Ills.) (Tire, stove and rivets only.)
Corbin Screw Corporation, New Britain, Conn.
Cook, Asa S., Hartford, Conn. (Automatic bolt and nut machinery.)
Continental Bolt & Iron Works, Chicago, Ill.
Champion Rivet Co., Cleveland, Ohio.
Church, Isaac, Toledo, Ohio. (Expansion bolts.)
Chicago Screw Co., No. 2 North Canal Street, Chicago, Ill.
Colorado Fuel & Iron Co., Pueblo, Colo.
Cleveland Chaplet Co., Cleveland, Ohio.
Chicago Nut Co. (Brass), Chicago, Ills.

D

Diamond State Steel Co., Wilmington, Dela.
Dunham Nut Co., Unionville, Conn. (Automatic nut machinery.)
Detrick & Harvey Machinery Co., Baltimore, Md.

E

Evens, T. H., Brooklyn, N. Y. (Expansion bolts.)
Eastern Bolt & Nut Co., East Providence, R. I.

F

Frost, L. B. (Estate of), Marion, Conn.

Franklin Moore Co., The, Winsted, Conn.

Fort Pitt Forge & Iron Co., Pittsburgh, Pa., Liberty and 25th streets.

Falls Rivet & Machine Co., The, Cuyahoga Falls, Ohio.
(Stove and fire bolts.)

G

Geometric Tool Co., New Haven, Conn. (Thread cutting, lathes, dies, etc.)

Gaskell, Wm. & Son, East 25th Street, New York City.

Greenlie, Wyatt & Co., New York City.

Graham Nut Co., Allegheny, Pa. (Successors to John Charles.)

Garland Nut & Rivet Co., Pittsburgh, Pa. (Works, West Pittsburgh.)

H

Hazel Atlas Glass Co., Wheeling, W. Va., successors to the Wheeling Hinge Co.

Hayden, A. & M., Philadelphia, Pa.

Hall's Son's Samuel, 229 West 10th Street, New York City.

Hoopes & Townsend Co., Philadelphia, Pa.

Haskell Manufacturing Co., Wm. H., Pawtucket, R. I.

Haberle & Graham, South Bend, Ind. (Bolt and nut machinery.)

Hubbard Manufacturing Co., Pittsburgh, Pa.

Howard Iron Works, Buffalo, N. Y. (Bolt and nut machinery.)

J

Jones & Laughlin, Pittsburgh, Pa.

K

Kirk, Latty Manufacturing Co., Cleveland, Ohio.
Kansas City Bolt & Nut Works, Kansas City, Mo. (J. H. Sternbergh & Son.)
Koepke Nut & Bolt Works, The, Elyria, Ohio.

L

Louisville Bolt & Iron Co., Louisville, Ky.
Lamson & Sessions Co., Cleveland, Ohio.
Lake Erie Iron Co., Cleveland, Ohio.
Lanz & Sons, Mathew, Pittsburgh, Pa.
London Bolt & Hinge Co., London, Ont.

M

Michigan Bolt & Nut Works, Detroit, Mich.
Mount Carmel Bolt Co., Mount Carmel, Conn. (Tire and stove only.)
Milton Manufacturing Co., Milton, Pa.
Morgan & Hare, Wilmington, Dela.
Manville, E. J., Machine Co., Waterbury, Conn. (Bolt and nut machinery.)
McCabe Hanger Co., New York City. (Expansion bolts.)
McInnes, Charles E., Drexel Bldg., Philadelphia, Pa. (Track bolts.)
Moran, William, Bolt Works, St. Louis, Mo.
Merrell Manufacturing Co., The, Toledo, Ohio. (Thread cutting lathes.)

N

National Machinery Co., Chicago, Ill. (Bolt and nut machinery.)
National Supply Co., Baltimore, Md. (Formerly Maryland Bolt & Nut Co.)

New England Bolt & Nut Co., Boston, Mass.
National Screw & Tack Co., Cleveland, Ohio.
New Castle Forge & Bolt Co., New Castle, Pa.
National Elastic Nut Co., Milwaukee, Wis.
National Bolt Works, Philadelphia, Pa.
North & Ferry, Cleveland, Ohio. (Automatic nut tappers.)
National Machinery Co., Tiffin, Ohio. (Bolt and nut machinery.)
Neely Nut & Bolt Co., Pittsburgh, Pa.
New Jersey Foundry & Machinery Co., 9 Murray Street, New York City. (Expansion bolts.)
Norwalk Manufacturing Co., Norwalk, Ohio. (Bolt cutting machinery.)
National Bolt Co., Pittsburgh, Pa.

O

Oliver Iron & Steel Co., Pittsburgh, Pa.
Ohio Bolt & Nut Co., Berea, Ohio, successors to the Ray Automatic Machinery & Bolt Co.

P

Payne Bolt Works, San Francisco, Cal.
Pittsburgh Screw & Bolt Co., Pittsburgh, Pa.
Peck, Stow & Wilcox Co., Southington, Conn.
Pawtucket Manufacturing Co., Pawtucket, R. I.
Pottsville Spike & Bolt Works, Pottsville, Pa.
Pittsburgh Forge & Iron Co., office Pittsburgh; works, Woods Run, Pa.
Pittsburgh Manufacturing Co., Pittsburgh, Pa. (Bolts, nuts and rivets.)
Pillow-Hersey Manufacturing Co., Montreal, Que.
Parmenter & Bullock Co., Gananoque, Ont.
Pratt & Whitney Co., Hartford Conn. (Screw cutting and nut tapping machinery.)
Pittsburgh Rivet Co., Pittsburgh, Pa.

R

Rhode Island Tool Co., Providence, R. I.
Republic Iron & Steel Co., Muncie, Ind.
Russell, Burdsall & Ward Bolt & Nut Co., Portchester, N. Y.
Rockford Bolt Works, Rockford, Ill.
Russell & Irwin, New Britain, Conn. (Tire, stove and rivets only.) Now Corbin Screw Corporation.
Reynolds & Co., New Haven, Conn. (Machine screws and bolts only.)
Ray Automatic Machinery & Bolt Co., The, Berea, Ohio.
Reliance Machine Co., Cleveland, Ohio. (Bolt and nut machinery.)
Reed & Prince Manufacturing Co., Worcester, Mass. (Tire, stove and stove rods and nuts.)

S

Sampson Bolt Co., The, Gananoque, Ont.
S. Severance Mfg. Co., Glassport, Pa.
Shelton Co., Shelton, Conn.
Scranton Bolt Works, Scranton, Pa.
Southern Bolt & Nut Co., Birmingham, Ala. (Now American.)
Standard Bolt & Manufacturing Co., Alliance, Ohio.
(Removed to Texas.)
Southington Cutlery Co., Southington, Conn. (Tire, stove and rivets only.)
Skelly & Co., Thos. P., Philadelphia, Pa.
St. Louis Screw Co., St. Louis, Mo. (Bolts and rivets.)
St. Louis Lock Nut Co., St. Louis, Mo.
Stewart & Romaine Manufacturing Co., Philadelphia, Pa.
(Expansion bolts.)
Star Expansion Bolt Co., New York City.
Seaman, Daniel C., 1638 Hutchinson Street, Philadelphia, Pa.
(Screws.)

Standard Engineering Co., Ellwood City, Pa. (Bolt cutting machinery.)

T

Toronto Bolt & Forging Co., Toronto, Ont.

U

Upson Nut Co., Cleveland, Ohio, (and Unionville, Conn.).

Union Steel Screw Co., Cleveland, Ohio. (Tire, stove, rivets and corrugated bolts.)

Union Nut & Bolt Co., 107 Chambers Street, New York City.

Union Nut & Bolt Co., Chicago, Ills.

W

Waterbury Farrell Foundry & Machine Co., Waterbury, Conn.

(Bolt and nut machinery.)

Worcester Machine & Screw Co., Worcester, Mass. (Tire and stove bolts.)

Wilson & Smith, Worcester, Mass. (Cold pressed nuts and washers.)

Wells Bros. Co., Greenfield, Mass. (Bolt cutters and nut tappers, tools, etc.)

Wrought Washer Manufacturing Co., Milwaukee, Wis.

Webster & Perks Tool Co., Springfield, Ohio. (Bolt cutters.)

Wiley & Russell Mfg. Co., Greenfield, Mass. (Bolt cutters.)

Y

Youngstown Bolt Co., Youngstown, Ohio.

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